



# NEW TECHNOLOGY JAPAN

Vol. 25 No.12 March, 1998

## INNOVATIVE PRODUCTION NOW

*Advanced GMP ( Good Manufacturing Practice) Standards at Plant for Production of High Quality Hospital and Clinical Use Medicines*

*-Kyushu Factory of Sawai Pharmaceutical Co., Ltd.-*

## NATIONAL R&D PROJECTS

*MITI New Measures to Promote Industrial Technology*

*—Stimulation of New Industries—*

## GENERIC TECHNOLOGY REVIEW

*Bionics: Study of dynamic characteristics of biological and related systems*

## HIGH-TECH INFORMATION

*Prevention of Thermal Denaturing of Proteins*

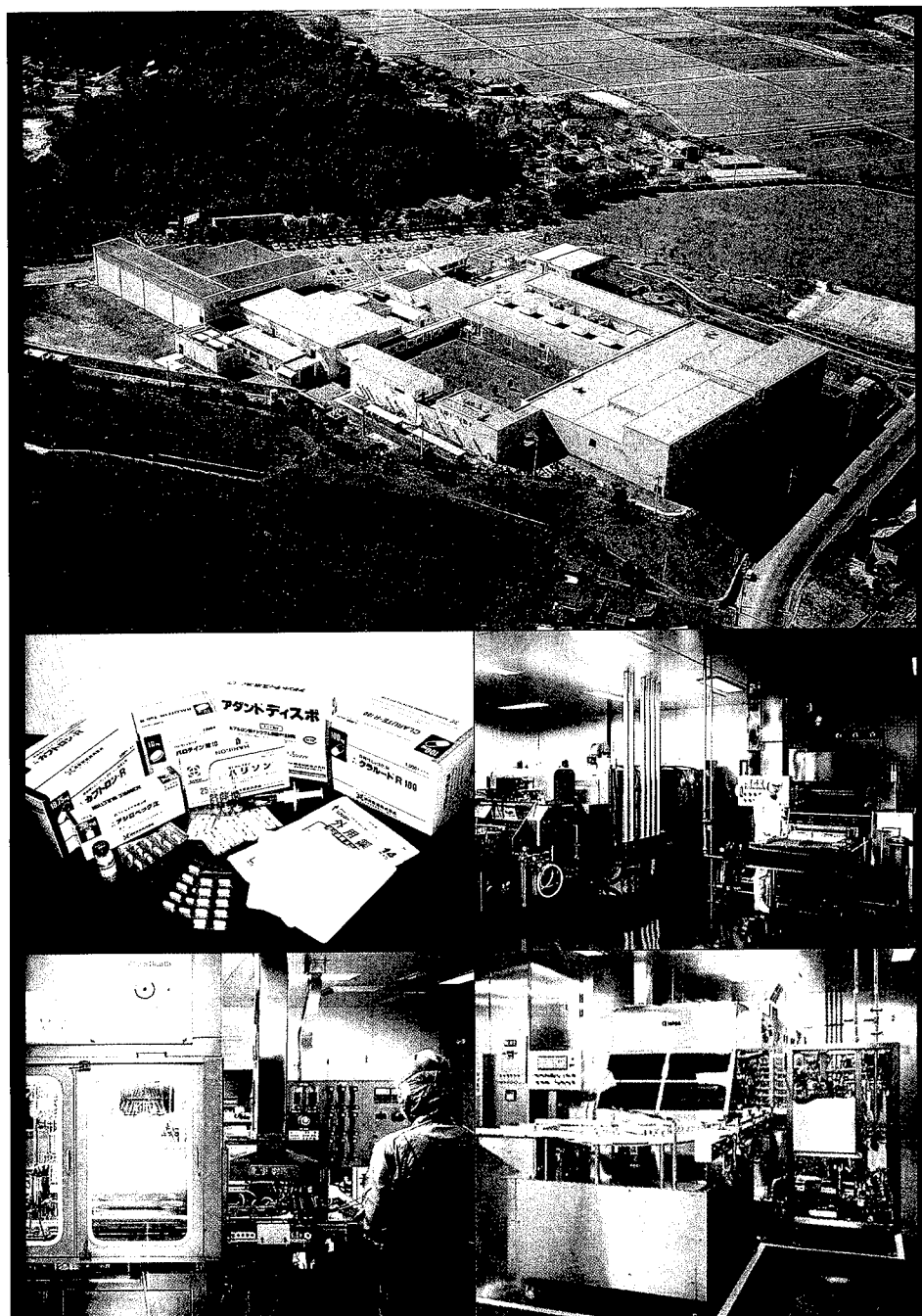
*Rice Cultivation Using Semiconductor Laser*

## SPECIAL FEATURES

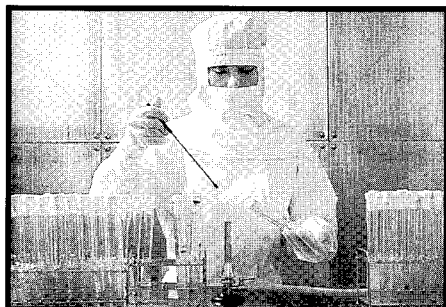
*Description of Designated Manufacturer System*

*Photon Measuring Technology*

*ISO 9000 Specifications Assessment and Accreditation*



The aim of our magazine is to promote the international exchange of technology through the introduction of Japanese New Technology.



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**Cover Photo:** Advanced GMP ( Good Manufacturing Practice) Standards at Plant for Production of High Quality Hospital and Clinical Use Medicines -Kyushu Factory of Sawai Pharmaceutical Co., Ltd.(Story on Pages2-5)

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# INNOVATIVE PRODUCTION NOW

*This section describes a specialized section or whole process of a representative factory which excels in specific aspects of production.*

## *Advanced GMP (Good Manufacturing Practice) Standards at Plant for Production of High Quality Hospital and Clinical Use Medicines - Kyushu Factory of Sawai Pharmaceutical Co., Ltd. -*

### Introduction

Broadly classified, there are two types of medicines, the generic medicines and the branded or patented medicines.

Generic medicines mean medicines in which the patent rights have terminated, but the medicine composition and effects are the same as the branded or patented medicines. Accordingly, generic medicines are produced with low costs and can be supplied at 20% to 60% reduced sales price.

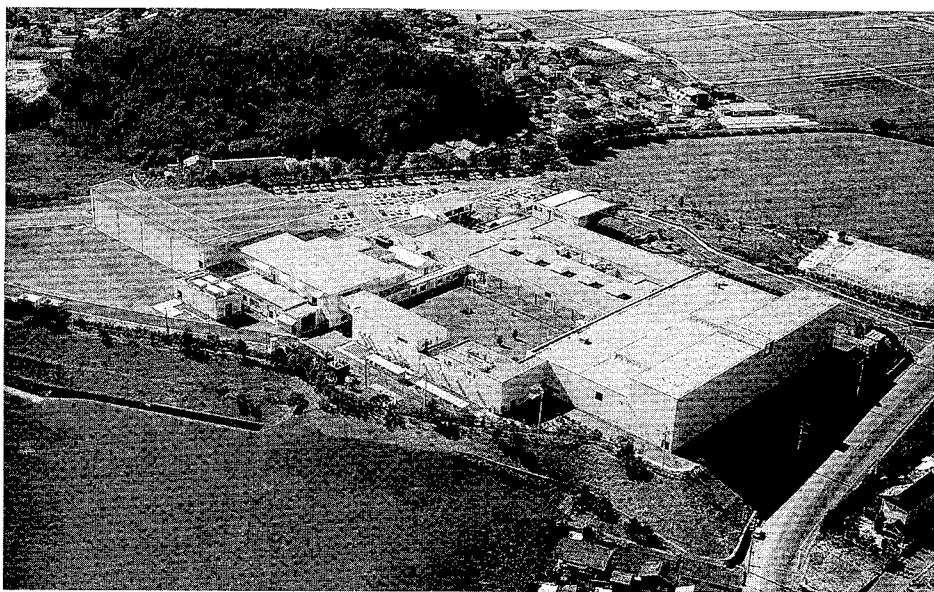
On the other hand, branded or patented medicines are medicines developed through the R&D including the manufacturing processes and machinery, so the medicine production costs include the R&D costs, and sales prices of branded or patented medicines are high.

Recently, the Ministry of Health and Welfare (MHW) has encouraged the production of generic medicines. For this, MHW has established the Good Manufacturing Practice (GMP) Standards, and guarantee the quality of generic medicines aiming to reduce total medical treatment expenditures by use of generic medicines in medical treatments.

Thus, generic medicines are expected to contribute to decreasing the national medical treatment expenditures as well as reducing patient costs.

Generic medicine manufacturers estimate the cost reduction to be about ¥900 billion if the present share of branded or patented medicines is replaced with generic medicines.

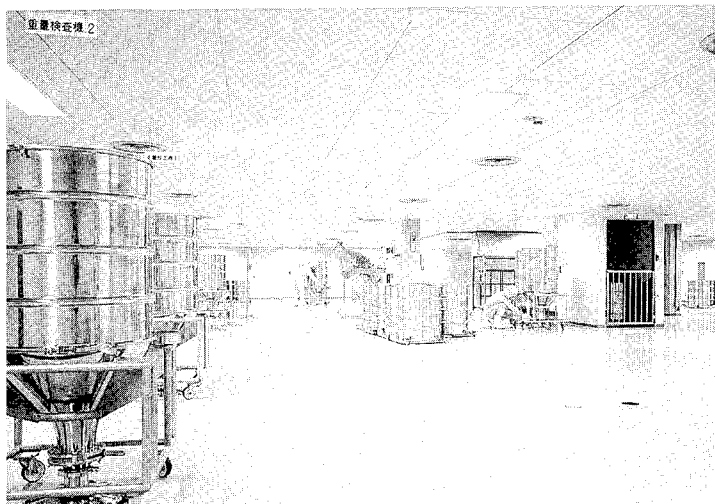
However, the share of the generic medicines is a small portion or only 10% of the



*Aerial view of the Kyushu Factory of Sawai Pharmaceutical Co.*



*Typical generic medicines produced at the Kyushu Factory*



Supply room

present Japanese medicine market compared with the U.S.A. (50%) and Europe (Germany with 65%).

This issue introduces the Kyushu Factory of Sawai Pharmaceutical Co. which was constructed using unique design concepts, and applied advanced operation know-how and most suitable production facilities. Sawai Pharmaceutical Co. is one of Japan's leading generic medicine manufacturers for hospital and clinical use applying its R&D results for patient friendly and easy use medicines. Sawai also produces OTC for Shiseido, but the portion is small.

## 1. Outline of Kyushu Factory

### (1) Location

The Kyushu Factory of Sawai Pharmaceutical Co., Ltd. is located in Iizuka City in Fukuoka Prefecture, Kyushu, about 1 hour and 30 minutes from Tokyo to the Fukuoka International Airport by airline and about 70 minutes by highway bus.

### (2) Outline of the factory

At present, Kyushu Factory has a land area of 70,300 m<sup>2</sup>, building areas of 15,000 m<sup>2</sup>, greenery areas of 18,438 m<sup>2</sup>, and environment preservation areas of 38,456 m<sup>2</sup>. Thus the factory is surrounded by greenery zones.

Total staff is about 160 including plant managers and clerks.

This factory has already received production permission for about 145 medicines from the Ministry of Health and Welfare, and at present is constantly producing about 60 products.

The Kyushu Factory was constructed based on 4 phases, 1st phase for construction of the antibiotic medicine manufacturing plant in 1981, 2nd phase for the general & syrup medicine manufacturing plant in 1983, 3rd phase for the injection medicine manufacturing plant in 1985, the freeze-dried injection medicine manufacturing plant in 1987, and the ointment medicine manufacturing plant in 1988, and 4th phase for the expansion of injection medicines and construction of packaging lines in 1989. So, this factory has the following medicines production lines.

1) Antibiotic medicines (tablet, capsule and dry syrups types)

2) General medicines (tablet, capsule, dry syrup, granulated, powdered and liquid types)

3) Injection medicines (liquid and freeze-dried types)

4) Ointment medicine (cream type)

5) OTC based on OEM

The capacity of major medicine production and packaging machinery and equipment are as follows:

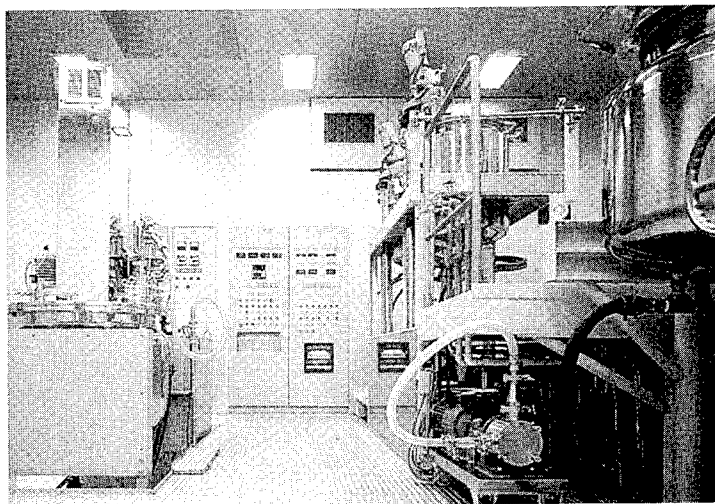
1) Tableting machines: 2.5 mil./day

2) Capsule and filling machines: 2.5 mil./day

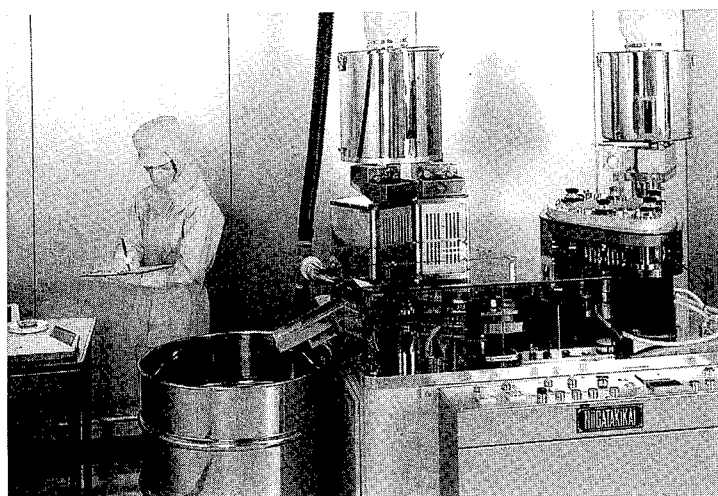
3) PTP packaging machines: 5 mil./day

4) Folded dose packing machine: 500,000 packs/day

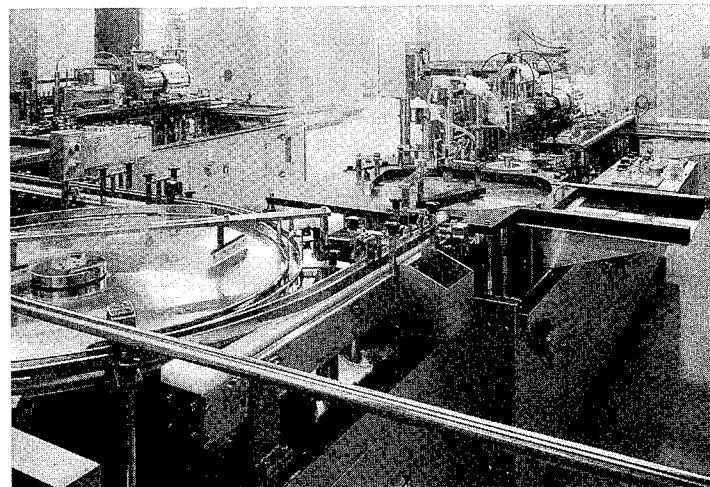
5) Syrup filling machines with bottle washing and drying function: 10,000 bottles/day



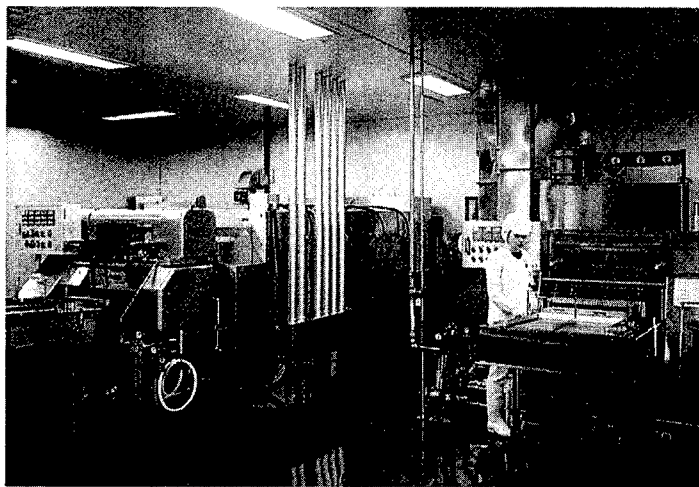
Ointment preparation room



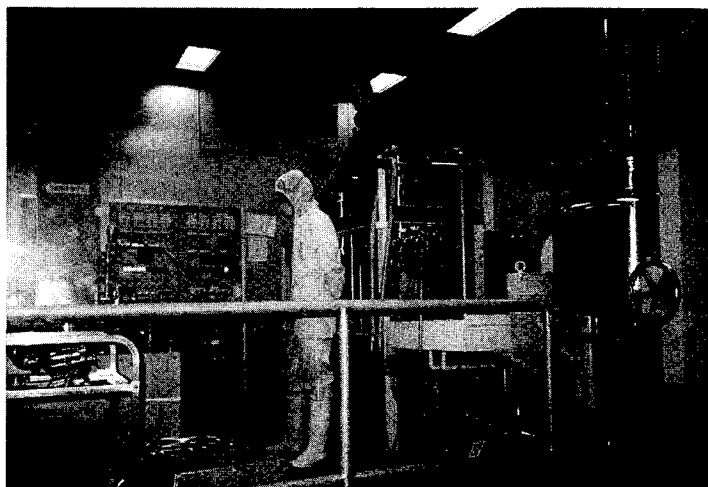
Capsule filling room



Fully automated vial filling & stoppering equipment



*Fully automated ampule cleaning, drying, and sterilizing equipment*



*Automatic medicine production lines*

- 6) Vial filling machines: 120,000 units/day
- 7) Freeze-drying machines: 110,000 units/batch
- 8) Ampule filling, sealing machines: 320,000 units/day
- 9) Sterilizing equipment: 200,000 units/day
- 10) Ampule packaging machines: 30,000 units/day
- 11) Stick packaging machines: 250,000 sticks/day

## **(2) Unique Plant Construction Concept**

The plant construction concept of this factory has adopted a unique design to pursue production of high quality medicines while maintaining a high sanitation environment with stable and uninterrupted operation during the stoppage of the utility power supply.

To maintain the high sanitation environment, the company developed an aluminum wall and partitions with the cooperation of the Showa Aluminum Co., Ltd. This aluminum wall and partitions has ex-

cellent features such as dust-free, antistatic electricity functions, and no dust contamination on the joints parts because the aluminum wall and partitions are joined vertically.

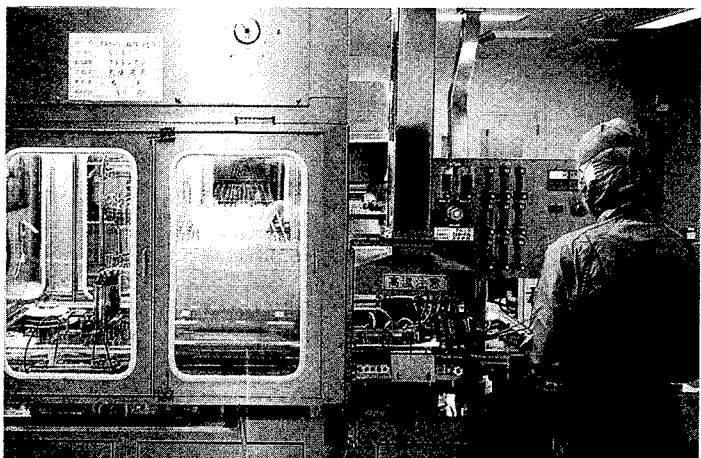
The air shower systems are installed in the entrance of the production rooms, and two air shower systems for rooms with the most severe air cleanness control.

To maintain the high sanitation environment in production rooms, this plant has adopted central air cleaning systems which perform air cleaning operations for each production room. Each production room has different clean conditions from the clean 1 level to clean 4 level (clean 5 level is atmospheric condition). For this, high performance air cleaner systems with high functional filters were installed, and waste room air is suctioned and supplied through air nozzle parts installed outside of production rooms.

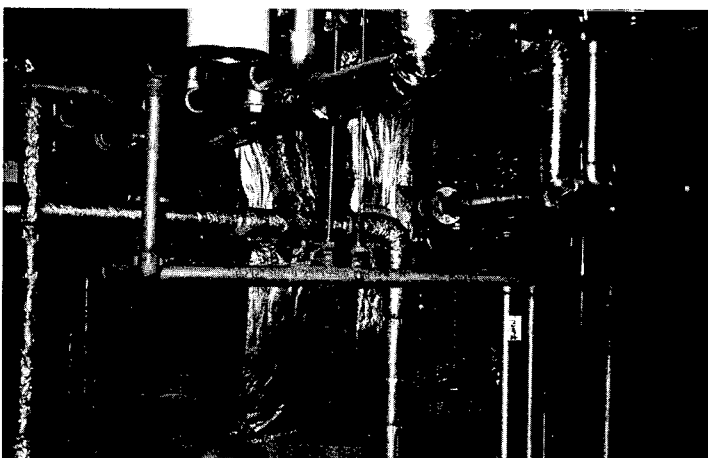
The clean 1 level production room maintains the highest clean air conditions by replacing all room air in a 30 second cycle.

For maintaining the stable continuous operations, the two level structure system is adopted for the production building. The top level is used for piping systems of raw materials and products, and air, gas, steam, electrical and information systems, and various control systems of these piping systems, and small size utility facilities.

Therefore, regular or daily maintenance work on the utility systems and equipment can be conducted without shutdown of production lines. Two 770 kW diesel power generators are also installed and housed in an independent building constructed outside of the production buildings. In production of medicines, the interruption of process operation caused by the interruption of power supplies, and other problems may damage the quality of medicines, and in this case, all materials or semi-finished products under the process will be lost. Therefore, stability is the essential in the medicine industry more than in other manufacturing industries. To avoid such a situation, the installed diesel power generators are operated synchro-

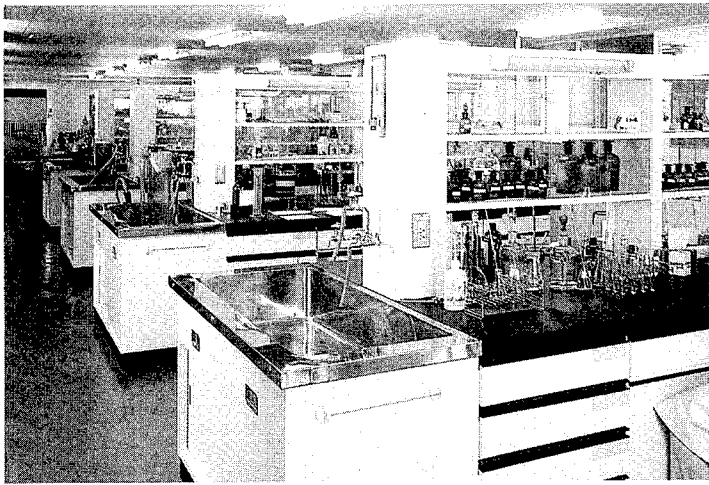


*Fully automated ampule filling and sealing equipment*

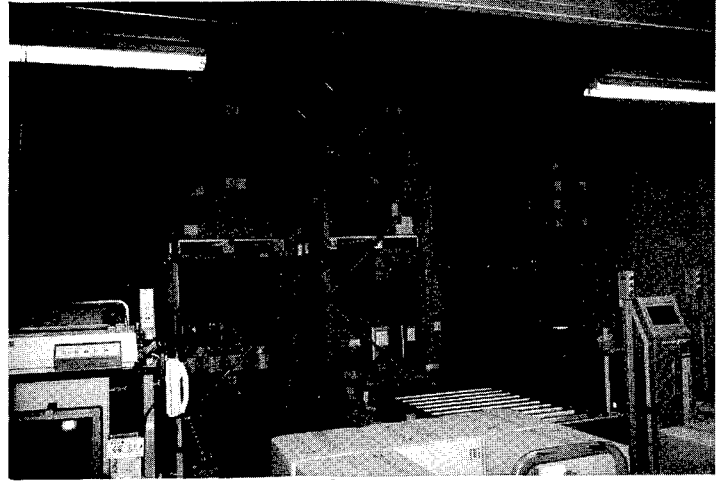


*Various piping systems installed of the top level in the production buildings*





*Quality testing room*



*Automatic warehousing systems for raw material and products*

nously with the electricity supplied from the power utilities.

Automatic rack warehousing systems are also installed along with the production rooms for receiving and storing raw materials and storing the finished products. Raw materials are supplied directly to medicine production rooms, and products are also returned to the automatic rack systems. Thus, the process from raw materials to finished products is managed via the automatic rack systems.

### **3. Batch Production System**

The production of medicines is based on the batch systems described earlier, so perfect washing and cleaning operations of reactors and pipings are required to avoid the contamination of foreign materials other than necessary raw materials and additives. This means that many requested washing and cleaning operations must be done in one day. So, strict inspection are provided for checking of washing and cleaning conditions.

In this factory, the performance of medicine production and medicine packaging are well coordinated to attain most economical and efficient production yields, and various production and operational techniques are established.

Fully automatic production lines and, partially manual operation lines coexist.

The procurements of raw materials both domestically and imported are the responsibility of the headquarters in Osaka, so Kyushu Factory receives necessary raw materials and quantities from headquarters.

### **4. Quality Control and Management**

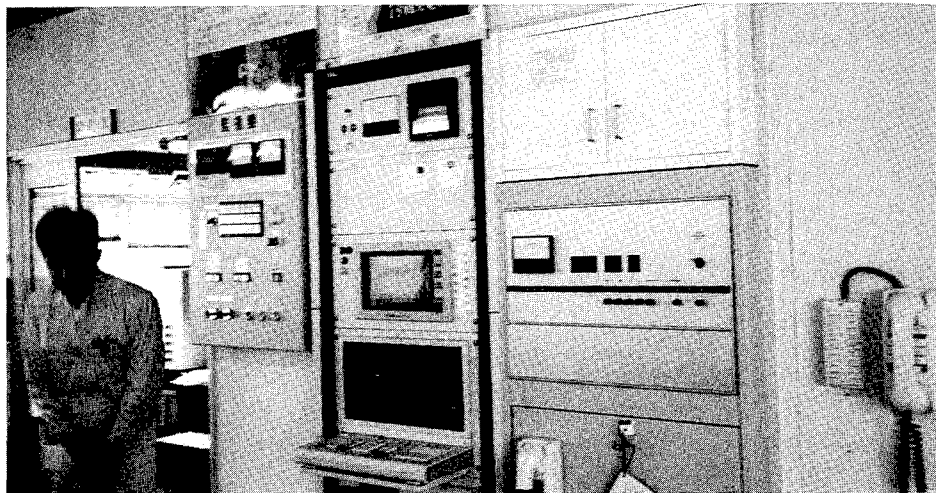
Quality control inspection is the key in medicine production both for raw materials and finished medicines. Accordingly, many staff are working in this department, and are independent from the production department. In this department, all medicines are checked strictly, and only the products passing the check are shipped to clients.



*Air shower room*

Storage rooms for the product sample are provided mainly in the quality control division, and some are also provided in production rooms. The medicines are preserved according to the preservation conditions of the hospitals or clinics. For example, medicines preserved in a room temperature at hospital or clinics are preserved at room temperature conditions, medicines preserved under cold conditions are preserved in cold condition rooms in the factory.

This is essential in a medicines manufacturing plant.



*Central control rooms for power supplies and preventive maintenance of utility facilities*

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# NATIONAL R&D PROJECTS

*This section describes various R&D projects being carried out in Japan on a national scale.*

## **MITI New Measures to Promote Industrial Technology —Stimulation of New Industries—**

The Ministry of International Trade and Industry, to create new industries and to meet the country's economic and social needs, is implementing comprehensive and aggressive research and development measures to search for new technological seeds and to develop technologies for the commercialization of these seeds.

FY 1998 Total R&D Budgets : ¥492.7 billion (an increase of ¥20.5 billion or 4.3% from FY1997)

### **Outline of FY 1998 Budget**

(Unit: ¥ Billion)

#### **1. Environmental Substantiation to Support the Creation of 15 New Industrial Fields**

The key to retaining and further invigorating economic activities in Japan will lie in the creation of new industries which are anticipated to create new job opportunities and to further expand the market. For this, a research and development system will be established with emphasis placed on the development and commercialization of technological seeds linked to industrialization. Also, rigid evaluation will be enforced to promote these research and development projects effectively and efficiently.

##### **(1) Emphasis Placed on R&D of 15 New Industrial Fields**

- Establishment of New Industry-Creation Type Industrial Science and Technology R&D System (30.0, +1.9)
  - \* Industrial Science & Technology R&D Project with University Participation (\*\*2.2, +2.2) \* Industrial Technology-Applied R&D Projects (2.1, +2.1) \* National Research Institute R&D Expenditures Relating to These Two Projects(\*\*0.1, +0.1)
- Industrial Technology Results Commercialization Subsidy (\*\*0.2, +0.2)
- Expansion of System to Offer Support Loans to R&D Enterprises by the Key Technology Research Promotion Center (26.0, ±0)
- Expansion of System for Public Invitation of Proposals for Creating New Industries (5.1, +0.4)
- Increase of R&D Expenditures to Invigorate Competition Between National Research Institutes (2.9, +0.7)
- Expansion of Inter-Ministerial Liaison in Special Research Projects Advanced by National Research Institutes (2.9, +0.5)
  - \* Clean Environment Technology Framework (\*\*0.6, ±0.6) \* Genome-Related Research {Gene, Biological Research} (0.6, ±0) \* Cerebral Science Research (0.9, ±0) \* Seismic Research Study (0.8, ±0)
- Establishment of New Industry Support Type Standard International R&D Project\* (\*\*0.7, +0.7)
- Bolstering of R&D Evaluation Setup (0.17, +0.12)

##### **(2) Steady Implementation of Environmental Substantiation Program for New Industry Creation (15 New and Growth Fields)**

- Fields Related to Medical Treatment and Welfare
  - \* Promotion of R&D of Medical Treatment and Welfare Equipment Technologies (3.1, +0.7)
- Fields Related to Information Processing and Telecommunications
  - \* Ultra-Advanced Electronic Technology Development Promotion Project (4.7, +1.6)
  - \* Promotion of Next-Generation Data Processing Basic Technology R&D

Projects {RWC} (5.9, -0.2)

- Fields Related to Environmental Preservation
  - \* Promotion of Development of Technologies Relating to Ozone Layer Protection Measures (1.1, +0.1)
- Fields Related to Biotechnology
  - \* Promotion of Coordinated R&D Projects Relating to Genome Analysis (27, +1.7)
  - \* Promotion of Research on Cerebral Science, Genetic Science and Biotechnology (1.5 ±0)

##### **(3) Promotion of International Research Cooperation**

- Promotion of Joint International Research and Researcher Exchange Particularly in Connection with National Research Institutes (2.1, +0.2)
- Promotion of International Cooperation on Basis of Private Enterprises (2.1, +0.3)
- Promotion of International Research Cooperation Relating of Global Scale Issues in Connection with Global Environmental Preservation (1.7, +0.1)

#### **2. Coordinated Promotion of New Links Between Industrial, Academical and Governmental Circles**

To utilize the research capabilities of universities and national research organizations in conformance with economic and social needs, R&D activities will be advanced under close liaison between industrial, academical and governmental circles. Also, to promote patent acquisition as well as the transfer and utilization of the research results by universities and other research organizations to the industrial world, necessary legal proposals will be submitted in the coming ordinary Diet meeting.

##### **(1) Promotion of R&D Projects and Smooth Industrialization of the Results**

- Expansion of Regional Consortium R&D Projects through Close Industrial, Academical and Governmental Liaison (3.2, +1.2)
- Industrial Science & Technology R&D Project with University Participation (\*\*2.2, +2.2)
- Continuation of Preferential Taxation System to Promote Joint Experiments and Research
- Substantiation of Liaison of National Research Institutes with Industrial, Academical and Governmental Circles, and Bolstering the Setup for the Administration of Research Results (0.4, +0.1)

##### **(2) Promotion of Technology Transfer**

- Establishment of Subsidy System to Promote Technology Transfer Among Industrial, Academical and Governmental Circles (\*\*0.05, +0.05) {Offering Subsidies and Providing Information in Connection with Technology Transfer Operations}
- Substantiation of Industrial, Academical and Governmental Liaison Facilities {i.e. Research-on-Campus Concept} Based on Private Sector Capability Utilization Act (0.9, -0.2)
- Establishment of Research Consignment System to Promote Creation of New Industries (\*\*0.03, +0.03)



### 3. Substantiation of Foundation to Support Intelligent Technology Creation Activities

To promote intelligent technology creation activities and to invigorate the incentives for R&D, measures will be established to protect pertinent intelligence as units. At the same time, the creation of new industries will be promoted through the utilization of related patents. Also, the foundation for intelligence technology creation will be substantiated, and standardization that is a decisive element for substantiating international competitive strength will be promoted from an international viewpoint.

#### (1) Substantiation of Intelligence Asset Protection System

- Establishment of Patent Market to Promote Active Distribution of Patents (2.5, 0.5)
- Promotion of Effective Utilization of Patent Information (9.0, +1.0)
- More Rapid Granting of Patent Rights (41.0, +31)

#### (2) Substantiation of Intelligence Technology Foundation

- Standardization of Measurements and Substantiation of Experiment and Evaluation Foundation (0.6, +0.1)
- Bolstering of Foundation of Biological Resources Information (0.3, +0.1)
- Bolstering of Foundation for the Safe Administration of Chemical Substances (0.3, +0.1)

#### (3) Promotion of International Standardization Activities

- Introduction of Project to Develop International Standards for Support of New Industries (\*\*0.7, +0.7)
- Introduction of Project for Optimization of International Standards (0.14, +0.14)

#### (4) Promotion of Standardization

- Assessment from Foundations of JIS Specifications (\*\*0.6, +0.6)
- Opening of JIS Mark Display System to Private Sector, and the Establishment of a System for Recognition of Scrutiny Enterprises (\*\*0.07, +0.07)

#### (5) Invigoration of Activities of National Research Institutes

- Increase of Funds for Promotion of Competition {Duplication} (2.9, +0.7)
- Substantiation of Fellowship System to Secure Talented Personnel (1.5, +0.1)
- Substantiation of Liaison of National Research Institutes with Industrial, Academical and Governmental Circles and Bolstering the Setup for the Administration of Research Results {Duplicated} (0.4, +0.1)
- Substantiation of Facilities
- \* Establishment of High-Speed Giganetwork Between Research Organizations (\*\*0.13, +0.13)

### 4. Promotion of Self-Induced Regional Economic Progress Supported by Private Sector Demand

R&D projects meeting the needs of regional industries advanced utilizing to the maximum limit latent regional technological capabilities through liaison of industrial, academical and governmental circles to actively promote the creation and progress of new regional industries.

#### (1) Promotion of Self-Induced Regional Economic Progress through the Promotion of Regional R&D Projects.

- o Expansion of Regional Consortium R&D Projects through Close Industrial, Academical and Governmental Liaison# {Duplicated} (3.2, +1.2)
- o Advancement of New Industry Creation Technology Development and Support System (4.3, +0.1)

### 5. Support of Small- & Medium-Scale Enterprises for New Industry Development and Foundation Bolstering

Coordinated implementation of measures to support unique and creative R&D activities of small- and medium-scale enterprises Forming the source of activity in the national economy.

#### (1) Culturing Personnel Supporting the Foundation of Product Manufacturing

- Implementation of Wide-Area Technological Training Support Program for Small- & Medium-Scale Enterprises (\*\*0.6, +0.6)
- Implementation of Project to Bolster the Foundation to Support Manufacturing Personnel (\*\*0.8, +0.8)
- Implementation of Project to Support Regional Manufacturing Deliberative Councils (\*\*0.3, +0.3)

#### (2) Support of Technological Development by Small- & Medium-Scale Enterprises

- Support of System LSI Development by Small- & Medium-Scale Venture Enterprises (\*\*0.3, +0.3)
- Substantiation of Fundamental Technology Research Project for Establishment of Small- & Medium-Scale Enterprises {Proposal Enlistment Type} (1.5, +0.3)
- Increase of Subsidies for Creative Technology R&D Projects (4.5, 0.5)

#### (3) Substantiation of Intelligence Asset Protection System (Duplicated)

### 6. Promotion of Development of Energy and Environmental Preservation Related Technologies

Japan is expected to assume the initiative in attaining the specific targets agreed upon at the Meteorological Change Framework Treaty Third Meeting of Participating Countries (COP) that was held in December last year. Therefore, for a balanced attainment of the objectives of CO<sub>2</sub> emission suppression, economic growth and stabilization of energy supply and demand, Japan is striving energetically in international cooperation projects to cope with the matters of energy conservation, development and utilization of new energy resources, development of innovative technologies and transfer of technologies to developing nations.

#### (1) Display of Initiative to Resolve Global Environmental Disruption Issues

- Advancement of New Sunshine Program {Coordinated Program to Develop Technologies Relating to Energy and Environmental Issues} (4.67, +1.9)
- Substantiation of Energy Conservation Measures and Promotion of Development of New Energy Resources (14.0, +2.3)
- Establishment of R&D Projects to Develop Immediate Effect, Innovative Technologies Relating to Energy and Environment (\*\*1.7, +1.7)
- Establishment of Special R&D Projects {Ministerial Liaison within Clean Technology Framework} (\*\*0.6, +0.6)

#### (2) Development of Technologies to Establish Environmentally Harmonized Industrial Structures

- Promotion of Smooth Recycling
- \* Establishment of Projects to Develop Technologies Relating to Recycled Products (\*\*0.3, +0.3)
- Establishment of Systems to Promote the Activities of Environmentally Harmonized Type Enterprises (\*\*0.5, +0.5)

#### (3) Promotion of Energy Security

- Development of Technologies to Secure Stable Supplies of Petroleum, LNG and LPG (28.5, -3.0)
- Promotion of Development of Clean Coal Technology and Transfer of Related Technologies (11.1, +0.1)

Note : \*\* New budget from FY1998

# GENERIC TECHNOLOGY REVIEW

## Bionics: Study of dynamic characteristics of biological and related systems

*This section describes various basic research and development activities in Japan to inform the world about generic R&D efforts here.*

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### Bionics: Study of dynamic characteristics of biological and related systems

#### *Electrotechnical Laboratory*

Biological substances are extremely complex systems in which many types and sizes of molecules cooperatively realize a variety of functions. According to the situation, the biological system responds to input stimulation very nonlinearly and, when transforming to a new equilibrium state, overall destabilization occurs due to amplification of small input signals and noise. To clarify the dynamic nature, we will simulate the phenomena and develop new measurement methods utilizing the technique in molecular biology.

#### 1. Analyses of Biomolecular Functions by Computational Simulations

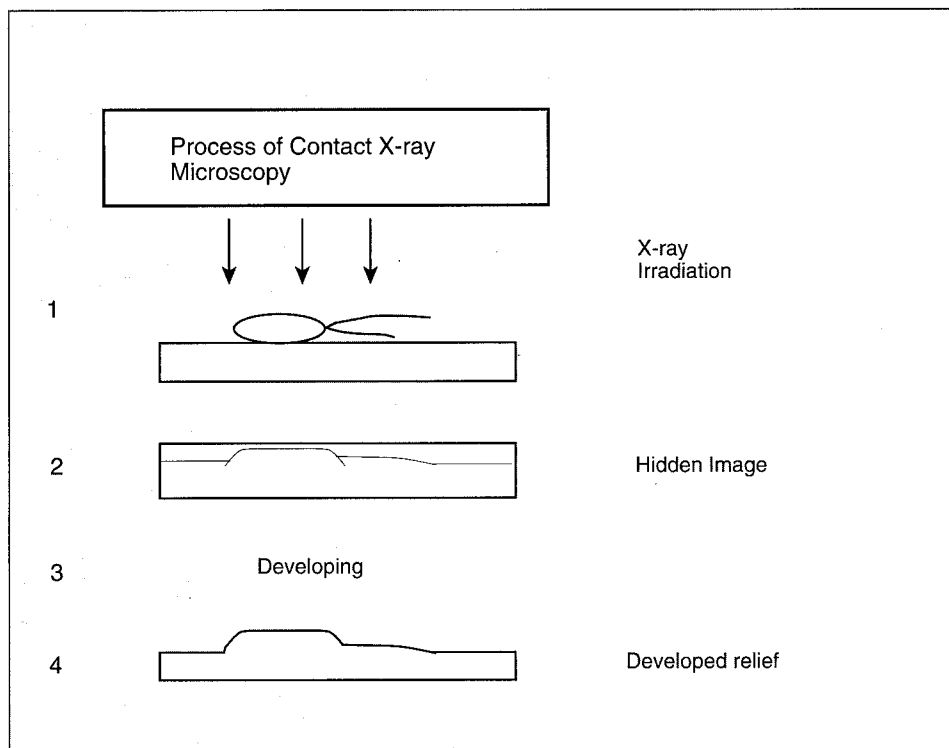
The structure-dynamics-function relations of biological molecules will be analyzed using computational methods, especially molecular dynamics simulation (MD). The computational methods and software are under development. Comparison of the computational results with experiments is also important. A software package for biomolecular simulation, PEACH, was developed by 1996 and a high-performance MD system constructed by installing PEACH to a special-purpose computer GRAPE (PEACH-GRAPE system). This system has enabled a high precision MD simulation with accurate treatment of the electrostatic interaction. Thus, we are using the system to analyze the biological molecules as well as improving the system. The biomolecular simulation system will be improved by adding sev-

eral new functions such as free energy calculation. Molecular dynamics simulations of ion channel, ribozyme, and trp-repressor will be used to analyze their functions. The computational results will be compared with experiments.

#### 2. Research on information incarnated in x-ray images of intracellular structures in living cells

X-ray images of living cells were obtained by using a flash contact soft x-ray microscopy system. The system consisted of a table-scaled YAG laser (3ns pulse width) for producing a plasma on a yttrium target for soft x-ray source, and a small vacuum chamber with a sample holder. An optical microscope and a CCD camera were used to observe specimens in the holder. The flash

project x-ray images of specimens were made on a PMMA layer supported on a silicon wafer. After chemical development, x-ray images were read out with an atomic force microscope to obtain enlarged images. Performance of the system was demonstrated by presenting x-ray images of unicellular microorganisms and spermatozoa. The intracellular structures were visible in some cases. These results demonstrate that the table-top x-ray microscopy system can obtain x-ray images of fragile structures of living cells, although a normal optical microscope using visible light can still be informative especially when combined with the x-ray microscope. A special sample holder will enable the simultaneous observation of the specimen with both types of microscope.



# High-Tech INFORMATION

March  
1998

98-03-100-01

## Prevention of Thermal Denaturing of Proteins

K. Iwakura and his research team of the Enzyme Design Group, National Institute of Bioscience and Human Technology, Agency of Industrial Science and Technology, have established a new technology to prevent thermal denaturing of proteins.

The terminal of a protein is bonded with a gelled compound to prevent protein aggregation with heat, by which irreversible denaturing and functional deterioration are suppressed. The protein non-thermal denaturing effect has been confirmed by using an enzyme employed in the synthesis of anti-cancer agents. The research team plans to apply the new technology to an enzymic process enabling protein cycling without deteriorating the protein functions even at high temperatures, and to a switching mechanism of advancing or stopping protein synthesis by temperature control.

With this new technology, the globular protein is bonded on the surface of a gel with a fixed interval to suppress the effect of protein aggregation with each other by heat and losing their functions. A method has been developed to attach the protein on the gel surface in which the carboxyl (C) terminal of the protein and the gel are bonded with ease. The cysteine parts of amino acids at the terminal parts are severed by cyanide (CN) treatment, and the exposed amino acid glycine joined with the gel. Proteins are bonded on the gel surface at probably 5-6 nm intervals, so there is no aggregation of proteins even after heat denaturing.

In experiments, an enzyme (protein) employed in the synthesis of anti-cancer agents was bonded with the gel and heated. After heating to 85 °C at which thermal denaturing normally occurs, the heat was lowered to 18 °C. Normally, an enzyme undergoing thermal denaturing loses its functions due to protein aggregation, but the enzyme bonded with the gel displayed its inherent functions and was usable for anti-cancer agent synthesis.

Proteins have various industrial manufacturing uses as catalysts for fermenta-

tion when synthesizing chemical substances of intricate structures. However, they are vulnerable to heat, so this characteristic had been a major obstacle to the development of systems to control the reversible activities of enzymes.

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98-03-100-02

## Rice Cultivation Using Semiconductor Laser

Hamamatsu Photonics K.K. has succeeded in cultivating rice by using a high-power semiconductor laser as the plant culturing light source. Rice plant (cv. Kitaibuki) seedlings were planted in hydropor containers. The seedlings were cultured hydroponically, using a semiconductor laser as the main light source and a blue fluorescent lamp as the auxiliary light source. The semiconductor laser emits light with a wavelength of 680 nm, which is a reddish light barely seen with the human eye, and which is known to be absorbed readily by chlorophyll.

Seedlings with leaf age of 2.5 were used (leaf age: the degree of seedling growth and indicated by the number of leaves), and rice was reaped in three months after

transplanting. Using seedlings with leaf age of 5-6 enables reaping to be accomplished faster to permit harvesting five times a year. This will permit rice production to be increased considerably, and the rice cost to be decreased substantially.

In contrast, rice seedlings planted at the same time and cultured with high-pressure sodium lamps (the most widely used type of lamp) were not in a state ready for reaping, which clearly indicates that red light of 680 nm with 5% of blue light is highly effective for rice plant maturation.

The semiconductor laser (laser diode) is a semiconductor light source used in optical communications as well as in CD players. It is compact and lightweight, the light can be contracted into a fine spot, and the light beam has a specific color (wavelength). In addition, the efficiency of converting electricity into light is as high as over 40%, or the highest among various types of light sources. It is made of a compound material consisting of gallium, arsenide, aluminum etc., and the color of the light can be changed flexibly by changing the ratios of these substances.

**\* Hamamatsu Photonics K.K.**

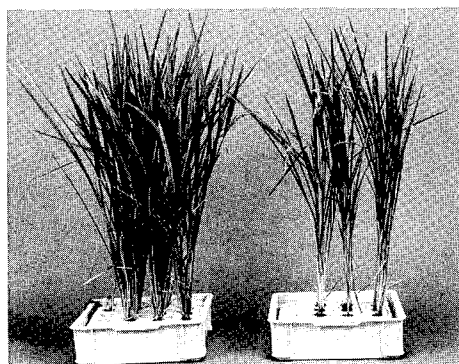
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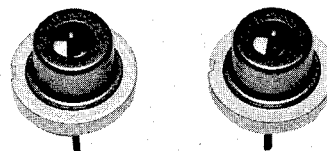
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Comparison of cultivation with high-pressure sodium lamp (left) and semiconductor laser (right). The plants on the right have a lesser number of leaves, but bear rice much faster

Semiconductor laser used in this experiment (outside diameter 9 mm).

Thirty of these diodes were used.



# **Special Features**

## **Description of Designated Manufacturer System**

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### **1. Introduction of the Designated Manufacturer System**

(1) To ensure the supply of accurate weighing equipment, the Japanese Weights and Measures Act obligates the manufacturers of specific measuring equipment to submit notification of participation in the business, and in principle requires the display of a qualifications approval seal on specific weighing equipment used in transactions and weight certification.

A type approval system has been introduced in this qualifications approval system in concert with the increasing structural complication and technological sophistication of specific measuring equipment, and specific measuring equipment acquiring type approval is in principle observed to comply with the technological standards prescribed for structural approval.

Partial performance differences cause the liability of errors arising with individual specific measuring equipment even with type approval, so independent structural tests of individual equipment are obligated even for specific measuring equipment of which the types have been approved (total number certification).

These systems are the basis of the Japanese Weights and Measures Act, and are similar to the systems adopted prior to the revision of the Weights and Measures Act.

(2) However, more recently, considerable improvements have been made in specific measuring equipment manufacturing technologies as well as in quality control, so that the test qualifications ratio has risen to a high level, and there are many manufacturers with no defective product in the type approval tests involving the testing of individual products.

Therefore, the continuation of total number certification with respect to all these manufacturers is unnecessary, as the work of testing exerts a considerable burden on administrative authorities, and the qualifications approval efficiency may deteriorate and reduce flexibility in coping with new weights and measures demands.

*Under these circumstances, the Revised Weights and Measures Act allows manufacturers who meet the Standards prescribed by the Quality Control System to en-*

*gage in voluntary (total number) testing of their products in conformance with the prescribed specific measuring equipment testing format and to affix qualifications approval seals on their own responsibility.*

Specific measuring equipment carrying such a manufacturer's seal are usable for measurements in transactions and for weight certification, so the seal has the same legal effect as the qualifications approval seal. These manufacturers are classed as designated manufacturers (designated by the Minister of International Trade and Industry), and this system is usually referred to as the Designated Manufacturer System.

### **2. Designation of Specific Manufacturers**

(1) Specific manufacturers are designated by the Minister of International Trade and Industry. This designation is given to a factory or workshop in conformance with the business of the domestic or foreign manufacturer applying for designation. The manufacturer must have acquired type approval for the specific measuring equipment, as the designation is provided for specific measuring equipment of approved type.

The designation is by factory or workshop as the product quality is determined by integrated attributes such as production facilities, worker quality level and technical expertise, which will differ with each factory or workshop even of the same manufacturer.

#### **(2) Application for Designation**

A domestic manufacturer wishing to become a designated manufacturer (description of application by a foreign manufacturer later) has to submit an application form to the Minister of International Trade and Industry. Applications by manufacturers of electrical instruments are submitted to the Bureau of the Ministry of International Trade and Industry, and applications by manufacturers of other specific measuring equipment are submitted via the governor of the prefecture concerned.

The items required on the application form are the following:

A manufacturer who submits an application to be named as a designated manufacturer is subject to in-

spections of the quality control methods of the factory or workshop concerned, which are conducted by the prefectural governor or by the Japan Electrical Equipment Testing Institute.

1. Name or trading name of the individual, the address and the names of representatives of a corporate organization.
2. Type of business.
3. Name and address of the factory or workshop.
4. Date of notification of engagement in manufacturing.
5. Description of quality control method.

### (3) Classification of Designated Businesses

The state of quality control will differ with different types of specific measuring equipment, so the designated manufacturer will be designated in conformance with the classification in Table 1. Regarding each specific measuring equipment, the classification system is enforced after a fixed period of time has elapsed for each respective business.

Non-automatic scale (electric type)  
 Non-automatic scale (other than electric type)  
 Weight and deadweight  
 Glass thermometer  
 Glass clinical thermometer  
 Resistance clinical thermometer  
 Hide area scaler  
 Service water meter (up to standard flow rate of 5 m<sup>3</sup>/h)  
 Service water meter (over standard flow rate of 5 m<sup>3</sup>/h)  
 Hot water meter  
 Automobile oil meter  
 Fuel oil meter for small vehicles  
 Fuel oil meter for large vehicles  
 Fine flow rate fuel oil meter  
 Stationary fuel oil meter, etc.  
 Liquefied petroleum gas meter  
 Gas meter (up to max. flow rate of 2.5 m<sup>3</sup>/h)  
 Gas meter (over max. flow rate of 2.5 m<sup>3</sup>/h)  
 Measurement tank with scale  
 Density float scale (other than pressure-resistant density flow scale), sake precision float scale and float scale type hydrometer  
 Pressure-resistant float scale type densitometer  
 Aneroid type pressure gauge (electrical)  
 Aneroid type pressure gauge (other than electrical)  
 Aneroid type blood pressure gauge (electrical)  
 Aneroid type blood pressure gauge (other than electrical)  
 Container type calorimeter  
 Junkers flow type calorimeter

Integrated calorimeter  
 Irradiation meter  
 Noise meter  
 Vibration level meter  
 Maximum power demand integrator, etc.  
 Special precision wattmeter  
 DC wattmeter  
 Densitometer (excluding sake precision float scale, glass electrode type hydrogen ion densitometer and glass electrode type hydrogen ion densitometer)  
 Glass electrode type hydrogen ion densitometer  
 Glass electrode type hydrogen ion indicator  
 Taximeter

Table 1. Classification of Designated Businesses

### (4) Designation Standards

1) The Minister of International Trade and Industry is empowered to recognize a designated factory or workshop only if the applicant factory or workshop is confirmed to conform to the preset standards for quality control methods. The term items relating to quality control methods and the standards included in the application items are as indicated in the table concerning Article 3 of the Ministerial Ordinance relating to Designated Manufacturers. Also, regarding the standards, the Ministry of International Trade and Industry is to set the details specifically required for each specific measuring equipment.

2) The designated manufacturer system is a system that eliminates tests by the government, and guarantees the accuracy levels of specific measuring equipment even if tests are exempted, so manufacturers must supply reliable products regardless of governmental tests.

The manufacturers are obligated to conduct self-imposed inspections, preserve test records and maintain fair practices, and to secure stable supplies of quality specific measuring equipment, manufacturers must introduce methods which would effectively suppress the generation of defective products in the stage of manufacturing.

The enforcement of self-imposed tests and preserving these test records are designed to replace governmental tests, but when these operations are advanced by private enterprises, there is a possibility of the quality control setup becoming inadequate and defective products generated despite self-imposed tests. In such a situation, there is a hazard of supply of faulty prod-

## Description of Designated Manufacturer System

ucts. Therefore, as a prerequisite for designation, and to limit the designation to enterprises which are unlikely to fall into such a situation, the Quality Control Method requires these manufacturers to conform to set standards.

3) The introduction of items relating to quality control methods and standards are based on the 9002 specifications of the ISO 9000 Series Specifications which are coming into rapid international use in recent years. Ordinary ISO specifications relate mostly to product specifications, but these specifications are designed to guarantee the implementation of prescribed quality control methods (such as clarification of the duties and obligations of responsible personnel and the documentation of work procedures).

The introduction of the ISO 9002 Specifications was determined since the enforcement of these quality control measures at factories which have attained a fixed level of performance in test qualification would increase the probability of these factories maintaining a fixed level of product quality. However, regarding specific measuring equipment, there are some product specifications which are the conditions for approval qualification, so the item of finished product control was added specially to enable compliance with the requirements of the product specifications (this condition is not included in the ISO 9000 Series Specifications).

4) Fixed limitations are imposed against manufacturers sanctioned for infringing against the Weights and Measures Act or whose designation has been cancelled.

### 3. Manufacturing Obligations of Designated Manufacturers

The conditions necessary to acquire nomination as a designated manufacturer are described above, and the conditions necessary for manufacturers nominated as a designated manufacturer in the manufacture of recognized types of specific measuring equipment given below.

#### (1) Obligations of Designated Manufacturers to Conform to Standards

An enterprise nominated as a designated manufacturer and manufacturing specific measuring equipment belonging to the types approved for its designated factory or workplace is obligated to conform to the approved structural technical standards, and to suppress equipment errors to below the approved error level.

An enterprise is named as a designated manufacturer on the precondition of its equipment having acquired type recognition in connection with specific designated measuring equipment, so a type-recognized manufacturer is governed by the manufacturing technology standards conformance obligation and subject to the standards conformance obligation in return for exemption from the testing of the specific measuring equipment of the recognized type. A correction order will naturally be issued with respect to standard conformance obligation infringement, but this obligation will not apply to the export equipment or to prototype products.

#### (2) Obligation to Conduct Inspections, Keep and Preserve Records

A designated manufacturer is obligated to conduct inspections of the specific measuring equipment manufactured at its designated factory or workshop, and to keep and preserve related records. The specific methods for these operations are prescribed by Article 7 of the Designated Manufacturer Ministerial Ordinance, the contents of which are as follows:

1. An inspection procedures form shall be prepared to confirm the conformance of manufactured specific measuring equipment to the technical standards prescribed by Article 71, Item 1, No. 1 of the Ministerial Ordinance of the Ministry of International Trade and Industry, and to carry out these operations strictly.
2. All manufactured specific measuring equipment shall be inspected to confirm that the error level does not exceed the level designated by Article 71, Item 1, No. 2 of the ordinance concerned of the Ministry of International Trade and Industry.
3. The technical standards of all manufactured specific measuring equipment shall be inspected in conformance with Article 71, Item 1, No. 1 of the ordinance concerned of the Ministry of International Trade and Industry and in connection with the items prescribed by Item 2 of the same article of the ordinance concerned of the Ministry of International Trade and Industry to confirm that they conform to the standards concerned.
4. An appropriate number of specific measuring equipment of each manufacturing lot shall be sampled to confirm that the specific measuring equipment concerned complies to the types for which they have been approved.



5. The specific measuring equipment shall not be shipped out until they have been confirmed to conform to all items prescribed by the inspection procedures form and are compatible with standards compliance obligations.
6. Inspection record sheets shall be prepared for each approved type to keep a record of the inspection results.
7. The inspection record sheets shall be preserved for over three years from the date of final inscription into these sheets, while regarding the approved types of specific measuring equipment prescribed by Article 72, Item 2 of the Ministerial Ordinance (specific measuring equipment with effective term of inspection), the inspection record sheets shall be preserved for over one year from the data of maturation of the effective term of inspection indicated by Article 96, Item 1 of specific measuring equipment listed in the inspection record sheets.

Methods of Designated Manufacturers to Conduct Inspections and to Keep and Preserve Related Records

### (3) Displays by Designated Manufacturers (Standards Compliance Seals)

Designated manufacturers, when engaging in the manufacture of specific measuring equipment of approved types at their designated factories and workshops, can affix this approval seal. This seal is called the standards compliance seal, with the shape as shown in Fig. 1.

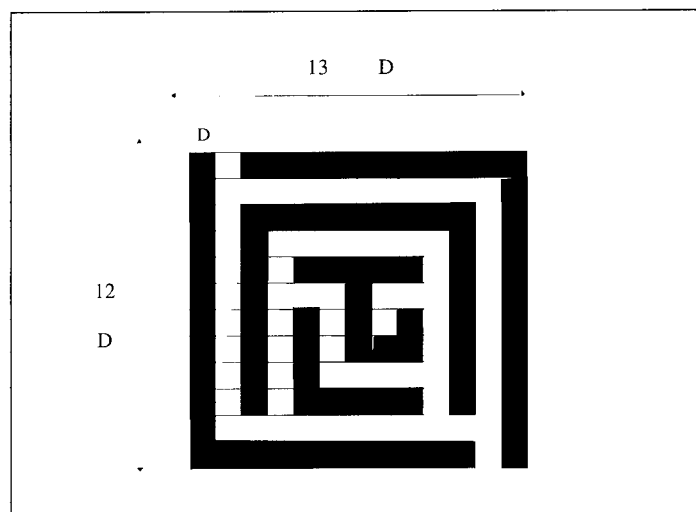


Fig. 1. Shape of Standards Compliance Seal

The standards compliance seal has the same effect as the inspection seal in the Weight and Measures Act and, as viewed from the act, is used as an inspection seal involving the standards compliance seal. Specific measuring equipment with an effective term of inspection as well as specific measuring equipment which are the targets of regular inspections and measurement verification tests require that the year and month of attainment of effective term as well as the year and month of display affixation are displayed in the same manner as the inspection seal.

Other than these cases, no manufacturer is allowed to affix any standards compliance seal on specific measuring equipment or to make any ambiguous display, and whenever a trader imports a specific measuring equipment carrying a standards compliance seal or any ambiguous display, he is obligated to remove these seals before selling or loaning out these equipment.

### (4) Improvement Order and Cancellation of Designation

The Minister of International Trade and Industry, whenever he recognizes that the quality control method of a factory or workshop does not conform to the prescribed standards or that the factory or workshop violates its standards compliance obligation, is empowered to order a designated manufacturer to improve the equipment and to make it compatible with the inspection of the specific measuring equipment concerned, or to make proper improvements in quality control operations. Also, the minister can cancel the designation of a designated manufacturer in the event the manufacturer causes these infringements.

These improvement order and designation cancellation measures, whenever a designated manufacture fails to reach the prescribed standards in the manufacture of specific measuring equipment, is designed to retain the overall system in good working condition by ordering proper corrections or through the cancellation of designation. Manufacturers subsequent to their designation are monitored through reports as well as through on-the-spot inspections to confirm that their operations are being advanced as prescribed.

### (5) Notification of Alterations

A designated manufacturer, whenever any application item relating to the quality control methods is changed, is obligated to notify the Ministry of Interna-

## Description of Designated Manufacturer System

tional Trade and Industry without delay. In this case, regulations are provided to suggest continuance of operations, submitting a document to verify the reality of continued operations and cancellation of designation.

### 4. Designation for Foreign Manufacturers

Foreign manufacturers can also be named as designated manufacturers. A foreign manufacturer desiring to be designated will have to submit an application to the Minister of International Trade and Industry in the same manner as domestic manufacturers. The standards for designation are identical to those governing domestic manufacturers, and the factory or workshop desiring designation is subject to inspections by the Ministry of International Trade and Industry as in connection with its quality control methods.

Foreign manufacturers, when engaging in the manufacture of specific measuring equipment at designated factories or workshops for export to Japan, are required to conform to the standards compliance obligations. Also, they will be subject to the same regulations applied to domestic designated manufacturers as in connection with designation standards, continuance of operations, notification of alterations, notification of termination of operations, cancellation of designation, cancellation of foreign manufacturer type recognition, conducting inspections and preserving inspection records, making proper displays, observing display limitations, observing improvement orders and cancellation of designation.

### 5. Correlation Between Quality Control Method and ISO 9002 Specifications

The objective of the designated manufacturer system is to eliminate the tests conducted by the government, and it is imperative that the accuracy levels of specific measuring equipment can be guaranteed even if these tests were eliminated. Therefore, the designation is limited to enterprises capable of conducting quality control effectively and efficiently. The items and standards relating to quality control methods require the establishment of a quality control setup enabling the stable and sustained manufacture of measuring equipment which are compatible with and fully conform to set technical standards.

Regarding the Quality Control Setup, the methods recommended by ISO 9002 (JIS Z 9902) are introduced which are widely used internationally as regulations relating to quality control and quality warranty. The ISO

9002 methods were applied since the introduction of these quality control measures with respect to factories and workshops which have attained a certain level of test qualification and other quality control performances is conceived to sustain and further improve the quality control and quality warranty levels.

The items relating to quality control methods and the ISO 9002 methods differ in composition as shown in Table 2, but the contents are essentially almost identical. Technical standards compatibility is defined under Item 9 Finished product control.

Quality Control Method	ISO 9002 (JIS Z 9902)
1. Quality warranty policy	4.1.1 Quality warranty policy
2. Organization	4.1.2 Organization
3. Reassessment by management	4.1.3 Reassessment by management
4. Quality control setup	4.2 Quality control setup
5. Document administration	4.5 Document administration
6. Material, parts procurement	4.6 Material, parts procurement
	4.7 Products supplied for customer control
7. Work subcontracting control	4.6 Work subcontracting control
8. Process control	4.9 Process control
9. Finished product control	—
10. Product discrimination and process traceability	4.8 Product discrimination and process traceability
11. Inspection	4.10 Inspection and testing
12. Discrimination of inspection	4.12 State of inspection and testing
13. Defective product administration	4.13 Defective product administration
14. Handling, storage, packaging and delivery	4.15 Handling, storage, packaging and delivery
15. Manufacturing facility and inspection facility	4.11 Inspection, measurement and testing facility administration
16. Correction and preventive measures	4.14. Correction and preventive measures
17. Quality control records	4.16. Quality control records
18. Internal quality monitoring	4.17. Internal quality monitoring
19. Education and training	4.18. Education and training
20. Statistical methods	4.20. Statistical methods

Table 2. Comparison of Quality Control Method and ISO 9002 Method Items

(2) Precautions in Quality Control Methods (Differences with ISO 9002)

1) Item 1. Quality warranty policy, involves the person responsible for management rather than the owner. The owner may not necessarily be a director, and the quality warranty policy is conceivably determined by the factory manager responsible for the factory management or the head of the business department.

2) Item 2. Organization, the qualifications of the persons responsible for promoting quality control are much more rigid than those of ISO 9002. This is because these persons are central to ultimate inspections in place of the usual approval operations, and are required to possess adequate knowledge and practical experience which can be adequately understood by third persons in general.

Therefore, these persons are central to this quality control system. Also, while there are regulations relating to substitutes for the person responsible for quality control operations, these substitutes should be appointed whenever the person responsible is absent. The term absent as used here is not conceived to include absences due to short-term business trips.

3) Item 9. Finished product control is not prescribed by ISO 9002 that consists of quality warranty regulations. However, since there are product specifications which are the conditions for qualification in the inspections of specific measuring equipment, the items quality control methods and finished product control have been prescribed especially to promote the compatibilities of these products with the technical standards in connection with product specifications.

Here, finished products are conceived to signify products which have passed final inspections and, in this case, the term final inspection is conceived to signify corporate inspection. The products which have passed the final inspections are regarded as finished products, and in finished product control, specific measuring equipment not satisfying the structural and error tolerance requirements prescribed by the qualifications inspection regulations must not be shipped out.

4) Item 10. Product discrimination and process traceability, the term traceability refers to the traceability of the chronology of all production processes from material procurement, parts manufacture and to the shipment of finished product. By this, it will be possible to clarify the correlations between the processing records and quality warranty records of specific measuring equipment. In the event there is some claim, it may not be possible to immediately pinpoint the cause by tracing the processes, but it will be necessary to assume some cause. There may not be any need to clarify the detailed causes as in connection with electronic components, but this method can offer a general insight into the probable cause. Therefore, it will be necessary for the system to enable tracing in lots.

5) Item 11. Inspection, the term final inspection is construed to replace approval, and constitutes a fundamental portion of this system. In-process inspection is conceived to be performed by some technician belonging to the manufacturing department, but the final inspection that is performed in place of approval should be performed by a person belonging to the quality control department who is directly under the supervision of the person responsible for promoting quality control. This is because the correlation between the person belonging to the manufacturing department and the person belonging to the quality control department is similar to that between administration and judiciary under the system of respective independence of the three powers of administration, legislation and judiciary, so the duties and the rights should be separated clearly. Especially with respect to the final inspection, there is a special need to perform the final inspection rigidly and fairly.

However, depending on the factory scale, state of manufacturing and other conditions, the person belonging to the manufacturing department and the person belonging to the quality control department may be the same person, and this may be permissible as long as the duties and rights of each department are clearly separate, and if it is clear that the final inspection was performed rigidly and fairly.

# Photon Measuring Technology

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## 1. Introduction

The development of technologies to measure various types of quantities sensitively and accurately is indispensable for improving reliabilities and efficiencies in the sector of production as well as for increasing the safeties of human society and environments. In order to secure the reliabilities of measurement results, it will be necessary to achieve further precision in the conventional methods of measuring mean values and to expand the measurement range to three-dimensional spatial distribution. Further, the establishment of a multidimensional data base incorporating elements such as time, wavelength and energy resources will be indispensable. To secure measurement reliability, a technique to conduct in-situ measurements without disturbing the measurement target will be a prerequisite. The realization of in-situ measurement will enable measurement targets to be traced in time sequence, and enable measurements to be conducted most efficiently.

The conditions for the realization of in-situ multidimensional measurement will consist of the following:

- (1) Establishing a technique for non-contact, non-invasive measurements.
- (2) Attainment of high levels of sensitivity and accuracy.
- (3) Establishment of compact, speedy and noise-free measurement systems.
- (4) Establishment of a technique for the quantization of measured results.

Various types of beam technologies can meet these needs. In particular, the photons from the domain of light to X-ray feature excellent versatility and are applicable to all kinds of environments, so their development should be taken up first. For this, it will be necessary to develop a beam source that is compact and features great brightness and broad wavelength, and a detector compatible with the beam source and featuring excellent sensitivity and detection over a wide range of wavelengths. Also, to link the beam source and the detector, it will be necessary to establish a technology to concentrate the photon within a fine domain, a technology to transfer photons at a high efficiency, and further a technology to control the photon wave surface.

These technologies are required to feature a definitely higher level of accuracy and resolution compared with technologies for other applications, such as beam technology for processing. Therefore, it will be impossible to make simple substitutions with a machining beam technology, and separate research will have to be implemented to develop a photon technology for measurement and analysis. Further, the three-dimensional internal measurement and analysis technique is an untapped field, so research will

have to be undertaken from the initial stage of probing into the fundamental principle of measurement.

In Japan, as a link of the Industrial Science and Technology R&D Program, a Photon Measurement and Processing Technology Project was implemented in FY 1995. The objective of this project is to establish an advanced measurement technology as well as a mechanical processing technology using a quality photon beam, improving the energy utilization efficiency and improving product productivity and reliability. By this, the application of laser measurement and processing technologies will be expanded in the industrial field, improve the safety of social and living environments, and create new industries.

In the field of measurement, the two following themes are under development:

### (1) Development of In-Situ Measurement Technology

To assess the state of a wide range of processing techniques including the photon processing technique, it will be necessary to use photons belonging to a wide range of wavelengths from the infrared to the ultraviolet domain, to develop basic technologies enabling high-sensitivity, in-situ measurements of state quantities, as well as systematization technologies to verify the soundness of these basic technologies. The compositions and densities of the impure gases and particles necessary for the processing environment, and the temperatures and shapes of the target substances, are evaluated to enable simultaneous measurements of multiple quantities. Therefore, various types of technologies will be established, including a wavelength control technology enabling scanning over of wide range of photon wavelengths. Wide-range, high-sensitivity two-dimensional detection technology, high-sensitivity technology to measure the ultraviolet photons emitted from the processing field, and a technology to control the wave surfaces of photons will also be developed.

Specific fields are the development of a technology to measure a gas density at a sensitivity of over 1 ppb in the infrared ray domain with an optical source wavelength scanning type absorption spectrometer, and the development of a technology to measure the contents of constituent elements of particles smaller than 30 nm at an accuracy of over 10% by emission spectrochemical analysis of up to the vacuum ultraviolet ray domain. Also, technologies will be established to enable measurements of the shapes of objects with an accuracy of about 10 nm (measurement distance 0.5 m) by applying interference technology enabling wave surface control, also a technology to measure internal temperatures at a sensitivity of 1 °C within the range from room temperature to about 1,000 °C.

## Photon Measuring Technology

### (2) Development of Non-Destructive Composition Measuring Technology

A technology will be established for the observation of surface structures as well as the state of chemical bonds at a high spatial resolution and high sensitivity by utilizing the high-density X-ray beam generated when a concentrated pulsed photon is irradiated on a substance, and by measuring quantum values such as the electrons and X-ray beams which are discharged when this high-density X-ray beam is irradiated on a structural body or material surface. A technology for imaging the penetrated signals which are generated when an X-ray beam is irradiated on a structural body will also be established to enable the evaluation of internal defects at a high spatial resolution.

Specifically, a high-brightness X-ray beam will be developed through laser beam wavelength transformation, and for the measurement of structures near the surfaces of solids using this X-ray beam, a technology will be established to detect impurities at a spatial resolution of over 30 nm based on photoelectronic spectroscopic measurements, a technology to detect impurities at a sensitivity of over 1 ppb in the domain of  $\mu\text{m}$  level by X-ray detection, and a technology enabling measurements of defects with a spatial resolution of over 1  $\mu\text{m}$ .

## 2. Development of In-Situ Measurement Technologies

### (1) In-Situ Measurement of Gas Composition and Density (Fig. 2-1)

The output of a wavelength-variable laser beam is irradiated in the measurement cell, and the output received with a quantum well type optical detector of high sensitivity in the infrared ray domain. At a wavelength in which the wavelength-variable laser beam wavelength congrues with the impurity gas absorption wavelength, the laser beam

will be absorbed and it will be possible to measure the density of the impure gas at a high sensitivity by measuring the absorbed wavelength. The laser beam, compared with a white light source, has an optical power that is about  $10^3$  times larger, so in the composition density measurements of narrow absorption spectral width as with a gas, accurate measurements are possible at a high signal-to-noise (S/N) ratio. Also, by capitalizing on the narrowness of the laser beam spectral width, it will be possible to introduce various methods for improving the S/N ratio by differential spectroscopy.

In order to establish these measurement technologies, it will be necessary to develop wavelength-variable lasers and high-sensitivity quantum detectors which are the main basic technologies indispensable for these advanced measurement technologies. The wavelength-variable laser system is developed by using a pulse laser and a wavelength-variable crystal, and by applying the optical parametric oscillator (OPO) or differential frequency technique.

The non-linear crystal employed for wavelength conversion is a crystal featuring excellent non-linear effect such as a lithium niobate or KTP crystal. Also, the high-sensitivity quantum type photo detector is produced by accurately laminating several dozen layers of thin films on a GaAs wafer and by precision control of the membrane thickness, by which it is possible to develop devices featuring optical sensitivities of 1.5-10  $\mu\text{m}$ , a sensitivity level not displayed by Si photo detectors. In this case, the D value that determines the S/N ratio of the photo detector, (or the specific detection capacity that is defined by the device area 0.5/equivalent noise power:  $\text{cm Hz } 0.5 \text{ W}^{-1}$ ), will be  $10^{11}$  at a wavelength of 2  $\mu\text{m}$  and  $10^9$  at a wavelength of 10  $\mu\text{m}$ .

### 2) In-Situ Measurement of Microparticle Composition and Diameter (Fig. 2-2)

Concentrating a pulse beam from a power laser to  $10^{10}$ - $10^{11} \text{ W/cm}^2$  and irradiating the beam on a microparticle will cause breakdown and convert the microparticle into plasma form. Inside the plasma, the substances comprising the particle will exist as ions of varying energy values, and excitation will occur by action of optical or thermal energy. Therefore, by spectroscopically detecting the light emitted from a plasma, it will be possible to obtain an emission spectrum from the ions as well as from the neutral atoms generated through rebounding with these electrons, making it possible to identify the compositions of these microparticles. Also, the intensity of plasma emission or ionic emission will be proportional to the particle volume, so it will also be possible to derive the equivalent particle diameter from the emission intensity. The advantage of

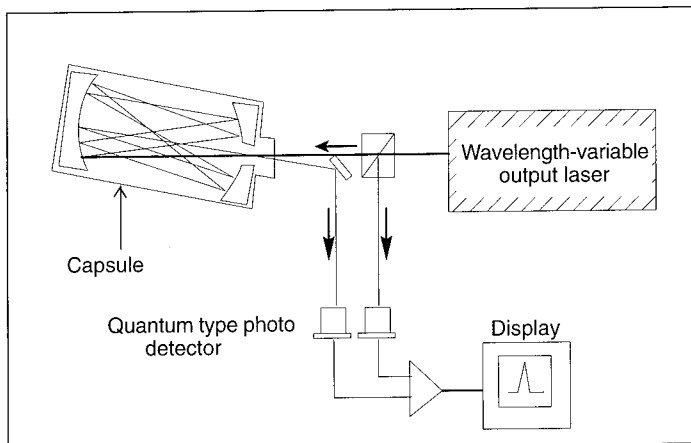


Fig. 2-1. Conceptual Diagram of Gas Density Measurement Technology

## Photon Measuring Technology

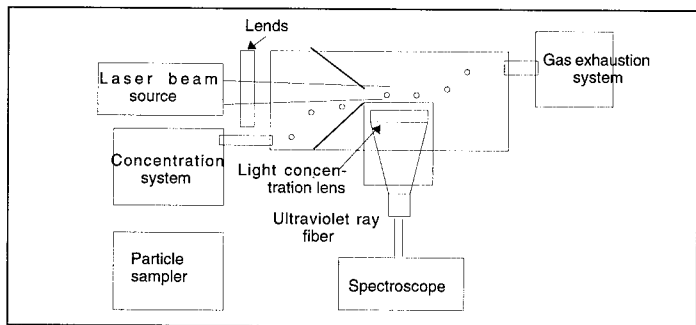


Fig. 2-2. Conceptual Diagram of Particle Measurement Technology

this method is that measurements are possible by non-contact with the target substance since the measurement is based on the use of light. Also, while the objective of this research project is to measure the microparticles in gases, the same method can be applied to the measurement of microparticles in liquids and in ultimate environments.

Emission due to breakdown causes various processes such as plasma emission, ion emission and atom emission by time division, and the emissions extend over a broad wavelength range from 0.9-0.17  $\mu\text{m}$ . Therefore, as the basic technologies for measurement, it will be necessary to de-

velop a fiber capable of transmitting light of up to 0.17  $\mu\text{m}$  and to establish a light guideway technology enabling the fiber handling. Also requiring development is a high-resolution spectrum measurement technology enabling measurement of atomic emissions, which will enable spectroscopic analysis of atomic emissions of up to 0.17  $\mu\text{m}$  and enable measurement of atomic emissions. It will also be necessary to experimentally fabricate a power pulse laser system for breakdown featuring a pulse width of 1 ns and enabling peak power intensity control within the range of  $10^{10} - 10^{11} \text{ W/cm}^2$ , and to utilize these basic technologies to develop a microparticle measurement technology for up to 30 nm.

### 3) In-Situ Shape Measurement Technology

The general method is to utilize light reflected by a mirror when measuring elaborate shapes. However, in this case, it will be difficult to measure target objects of large vertical surface changes and inclined surfaces. In order to realize non-contact measurements of three-dimensional shapes of free curvatures that is in great demand recently, it will be necessary to develop new measurement technologies which utilize the extremely weak scatter light from the object surface. Conventional types of technologies pro-

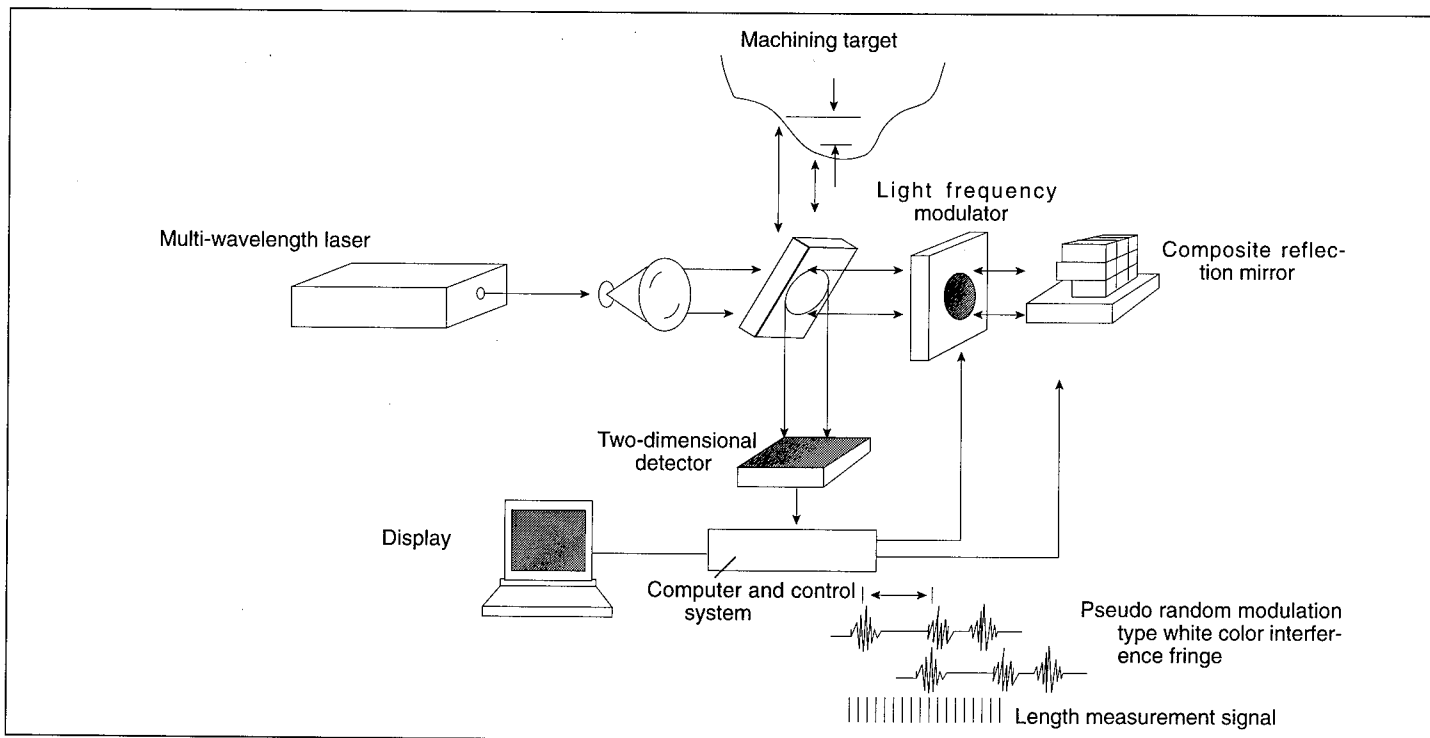


Fig. 2-3. Conceptual Diagram of In-Situ Shape Measurement Technique



## Photon Measuring Technology

pose the utilization of large optical pulse energy as the light source, but the energy not only causes target object thermal distortion but also increases the background light of intense energy. This situation immensely aggravates the S/N ratio of the detection light and prevents accurate measurements in the nanometer order.

To cope with this problem, a pseudo random modulation type white light interference technique will be developed. Length measurement by the white light interference technique has been established to a considerable level, but the measurement of surfaces of extremely low reflection ratios has not been realized as yet. The plan is to conduct pseudo random modulation of the referential light guide-way length, photoelectrically detect the white light interference fringe generated by the weak light from the object surface and the random phase-modulated light, and perform rapid correlative treatment with respect to a standard signal. As a result, it will be possible to detect weak light beams reflected from the object surface at a high sensitivity in the photon order, also enable elimination of the adverse influences of the background light that is much more intense than the signal light. Fig. 2-3 shows the conceptual diagram of the system.

The white light source is provided by a multi-wavelength laser beam. As shown in the diagram, multiple plane mirrors in random stepped alignment are used as the referential mirrors, and scanning these mirrors provides a random time series of white light interference fringes. The time series of each point is measured with a two-dimensional detector, and the object shape derived by correlation treatment. Further, to derive the absolute dimensions of the shape accurately in actual environments, the plan is to develop a highly efficient wavelength conversion technology utilizing non-linear optics, and a bichromatic light wave interference measurement technology to correct the air refractive index variations at an accuracy better than 1 ppm.

### 4) In-Situ Temperature Measurement Technology

Up till now, the temperatures of materials was measured using thermocouples and radiation thermometers, but these equipment are for measuring the surface temperatures of the target materials and cannot be used for measuring internal temperatures. The sound wave propagates well inside materials and the propagation speed is changed with the temperatures of these materials. Therefore, by measuring the sonic speeds, it will be possible to measure internal temperatures. Measurements with the contact type sonic sensor have been attempted in the past, but adequate measurement resolution was not obtained due to the lack of measurement stability. Against this backdrop, attempts

were made to develop a measurement technology using the laser beam that enables precision sonic measurements and which is usable in-situ in environments.

This technology, as shown in Fig. 2-4, generates a sound wave by heating the surface of a material locally, and the weak vibrations on the surface of the specimen are detected with a laser interference gauge to measure the sonic speed. The issue is to establish a highly accurate sonic measurement technology. A sonic pulse sequence is generated inside the material with an optical pulse sequence having a fixed time interval, and the sonic speed measurement resolution improved by detecting the phase of the excited sonic wave. The phase of the sonic wave can be measured in a frequency of about 1/100, so by exciting a sonic wave of over 10 MHz, it will be possible to measure the sonic speed with a resolution of  $10^{-4}$  for the realization of a temperature resolution of  $1^{\circ}\text{C}$ .

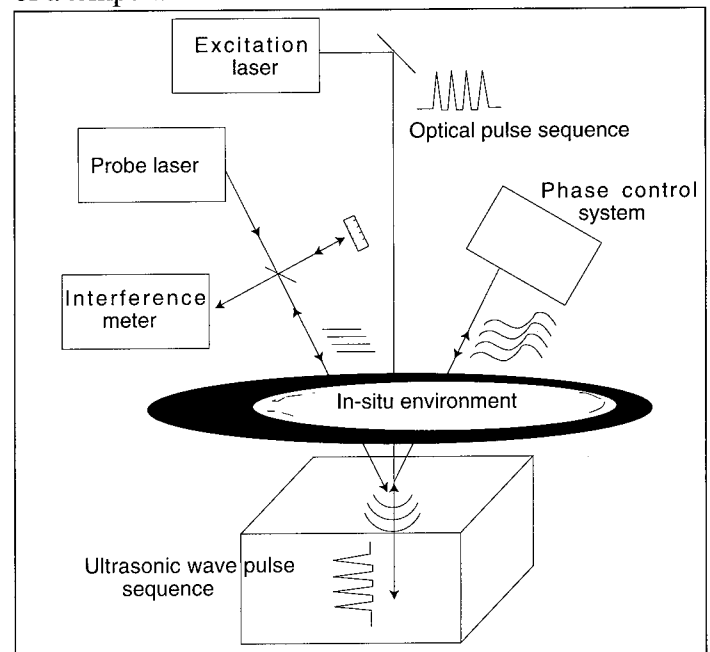


Fig. 2-4. Concept of In-Situ Temperature Measurement System

Various types of disturbances which distort the wavefront of light exist in the actual environment, such as mechanical vibrations, optical oscillations and scattering arising from the coarseness of specimen surfaces. These optical wave front disturbances aggravate the measurement sensitivity immensely, making the detection of weak sound waves difficult. Therefore, a technology will be established to compensate the wavefronts of light which are aggravated by various disturbance factors by using a wavefront compensation device based on phase conjugation.

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A photorefractive material featuring a quantum well structure will be developed by growing extra-thin semiconductor films of high resistance for use in a wavefront compensation device. This device undergoes semiconductor energy structural change due to the quantum effect, and manifests an extremely sensitive, rapid photorefractive effect. To produce a device featuring high sensitivity, lamination of about 100 layers of very smooth, extra-thin atomic-level films on an area several square millimeters wide is necessary. For this, a wafer with special face orientation (411) is used for crystal growth, and a technology is introduced to control the growth conditions such as the wafer temperature, raw material pressure and feed ratio to provide favorable results.

The combined use of this super smoothening technology and the crystal resistance improvement technology will permit the development of a highly sensitive, high-speed photorefractive device featuring excellent response on the microsecond order necessary for in-situ measurements. By this, it will be possible to increase the response speed by about a hundred times with the same light quantity compared with the fastest existing device. The target is to develop a device featuring a response faster than 10 microseconds with a weak light quantity of less than 1 mW/mm<sup>2</sup>. Further, the phase conjugate function of the developed material will be evaluated to determine an optical system featuring optimum response and sensitivity.

### 3. Non-Destructive Composition Measurement Technology

#### 1) Development of Internal Transmission Measurement Technology Using Shortwave Light

An extra-bright hard X-ray beam of excellent transmission force must be used to analyze the internal defects of composite materials and to rapidly detect wiring disorders of integrated circuits. When the target (solid substance) is irradiated with a concentrated laser beam of great inten-

sity, a high-density plasma is formed that emits X-ray beams. The generated wavelength is concentrated in the soft X-ray domain of wavelengths longer than 0.5 nm, but more recently, there are reports of the efficiency of generating hard X-ray beams being improved substantially by irradiating a short-pulse laser beam of sharp peak as fast as in sub-pico second speed, or by impressing the target with a high voltage (100 keV level).

In this research project, to develop a high-brightness X-ray source of shorter wavelength, a sub-nanosecond pulse YAG laser beam (pulse width 200-500 ps) of sharp peak and narrow pulse width is irradiated on a diameter of less than 10  $\mu\text{m}$  on the target and, at the same time, a high voltage is impressed on the target, by which the efficiency of conversion from the laser to hard X-ray domain is improved substantially.

A non-spherical mirror and its optical system will be developed to contract the beam source diameter of the hard X-ray beam (1-0.01 nm) generated by the light source of 10- $\mu\text{m}$  size to less than 1  $\mu\text{m}$  by developing precision grinding technology. Further, the non-spherical mirror will be fabricated in multi-strata film form to attain a high reflection rate in the shortwave domain. The hard X-ray beam emitted from the light source of 1  $\mu\text{m}$  diameter is irradiated on the specimen, and a specific cross-section of the specimen is imaged at a spatial resolution of 1  $\mu\text{m}$  by taking cross-sectional and strata photographs of the transmission image by the digital tomography (DT) technique can detect defects and impurities inside the specimen. The specimen and the detector (CCD) can be accurately adjusted in three dimensions, and digital synthesis of the signals provided by the detector permits multi-stage photography to enable three-dimensional analysis of defects (see Fig. 3-1).

It is assumed that X-ray beams of extremely sharp peak values and wavelength distribution of wide range are generated by the high-brightness pulsed light source. At

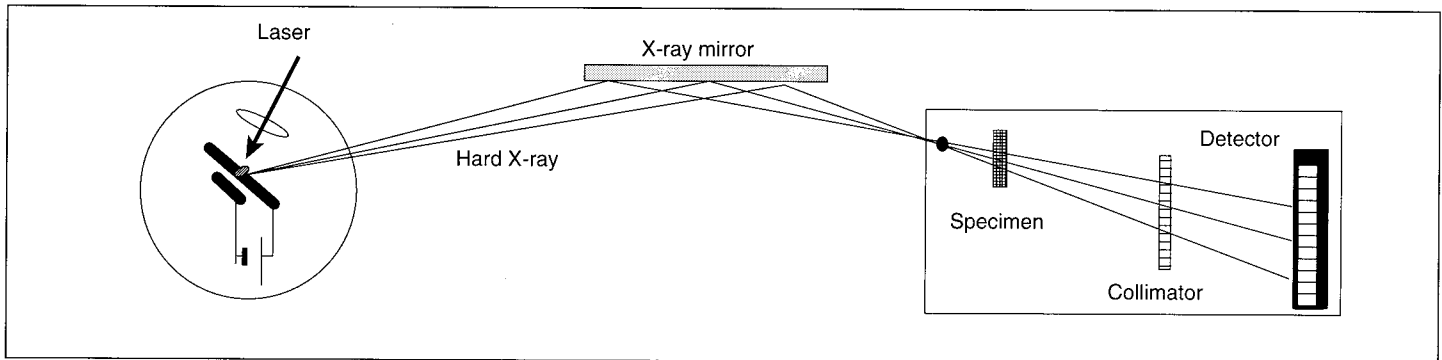


Fig. 3-1. Internal Transmission Measurement System

## Photon Measuring Technology

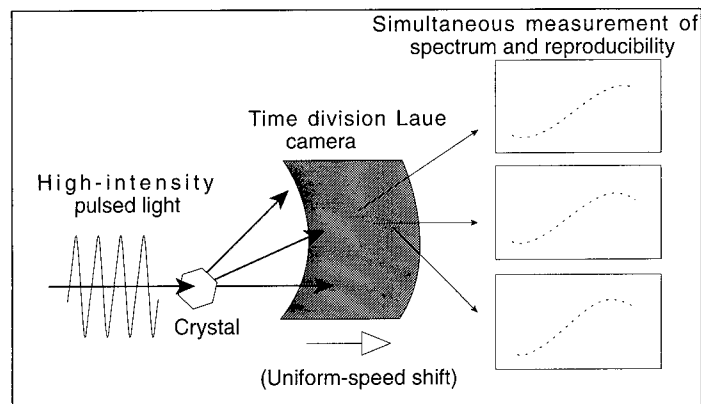


Fig. 3-2. Conceptual diagram of High-intensity Pulsed X-Ray Beam Evaluation System

present, a semiconductor detector is being used as a simple tool to measure X-ray intensity and wavelength distribution, but it is unsuitable for measuring high-brightness pulsed light sources due to its long period of insensibility as well as due to its miscounting. The same can be said of the scintillation counter.

As for the type of detector that temporarily stores the energy of the photon

injected inside as with an imaging plate, or with an integrating type detector, there is no miscounting. By incorporating such an integrating type detector with a mechanism that records the pulse light with a lapse of time, it is conceived that it will become possible to evaluate the reproducibility of the intensity distribution of the X-ray beam wavelengths generated by a high-brightness pulsed light source that is under development. Fig. 3-2 shows a conceptual diagram of the high-brightness pulsed X-ray evaluation system.

The spectroscopic high-intensity pulsed light generated by the crystal is stored simultaneously in the integration detector, so as long as the quantity of light from the light source is adequate, a spectrum of the light source can be obtained with a single pulse. The position (refractive angle) information corresponds to the energy wavelength. The detector is shifted horizontally, and multiple spectra recorded sequentially in the detector enable reproducibility evaluation.

### 2) Development of Photon Spectroscopic Technology for Ultraminiature Field Analysis

The ultimate method of instantaneous non-destructive analysis with a next-generation high-concentration device will be the photon spectroscopic method using nanosize high-brightness X-ray beams to investigate the gigabit DRAM. In this research project, the objective is photon spectroscopy by irradiating the specimen with an X-ray beam concentrated to 30 nm.

The shortwave light source is a soft X-ray beam generated by the laser plasma described in section 3-1, and the high-brightness monochromatic light beam radiated from a carbon plasma. For the light concentration system to provide a high-intensity, ultraminiature beam of 30 nm size on the specimen, a Schwartz shield? type direct-incidence mirror will be developed.

The beam from the high-brightness light source is irradiated on the specimen, and the specimen surface composition and state analyzed by measuring the photon energy generated by the beam. Up till now, an electrostatic analyzer had been used for conducting photon analyses, but the efficiency was quite poor and much time was required for the analysis. In this research project, a system will be

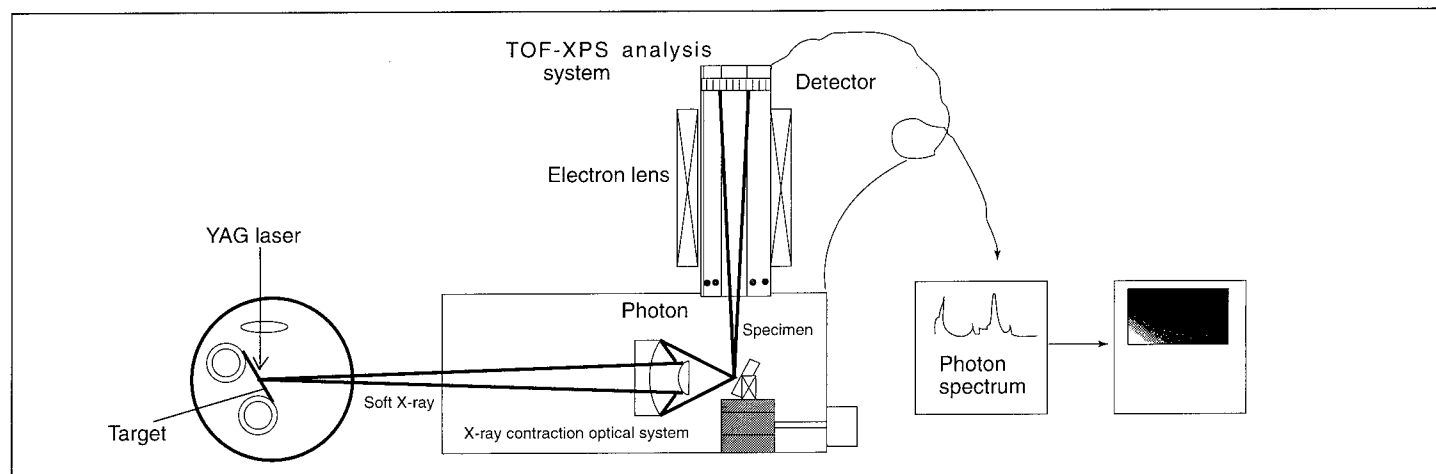


Fig. 3-3. Photon Spectroscopic System

## Photon Measuring Technology

developed (TOF-XPS) that utilizes the flight time difference of the pulsed photons generated by X-ray irradiation.

The electronic optical system will use a magnetic lens comprised of a scatter magnetic field and capable of detecting photons at a higher collection efficiency than that of conventional systems with the objective of attaining a collection efficiency of over 10% (see Fig. 3-3). In connection with imaging, the specimen will be scanned on the light collection point to obtain a two-dimensional image (spatial resolution 30 nm) with specific energy. At the same time, a scanning mechanism will be developed that will not deteriorate the spatial resolution.

### 3) Development of Technology for Ultrahigh Sensitivity Detection of Shortwave Light

A fluorescent X-ray beam is generated when a highly concentrated X-ray beam, generated by concentrated shortpulse photon irradiation on a substance, is irradiated on a structure or on the surface of a material. A technology will be developed to measure the compositions in the proximity of surfaces at a high sensitivity by measuring this fluorescent energy with a high-energy resolution detector.

For example, when ultrafine quantities of metals such as Cu and Fe are precipitated near the surface boundaries of a Si semiconductor device, this device becomes defective. To accurately specify the cause by a non-destructive method, it will be necessary to obtain spectra of small domains in the  $\mu\text{m}$  order at a lower limit detection level of less than 1 ppb. At present, analysis to the order of 1 ppb in the domain of a few square centimeters is possible, but this will not permit accurate pinpointing of faulty points, so the lower limit of detection lies on the 1 ppm level in ultrafine domains on the  $\mu\text{m}$  level, making analysis to a precision of 1 ppb impossible.

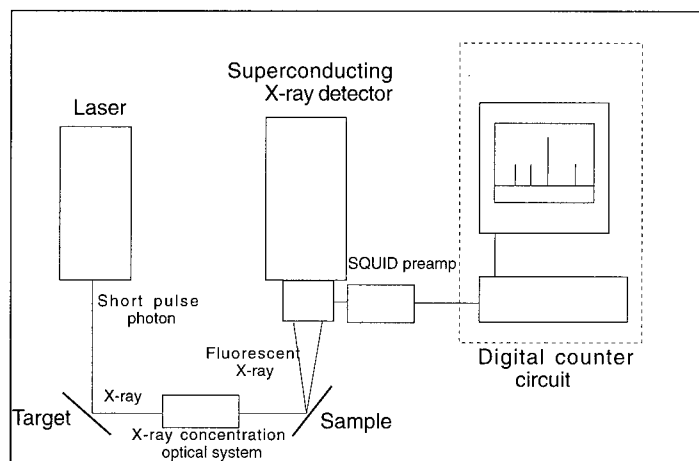


Fig. 3-4. Conceptual Diagram of Ultrahigh Sensitivity Detection System for Shortwave Light Beams

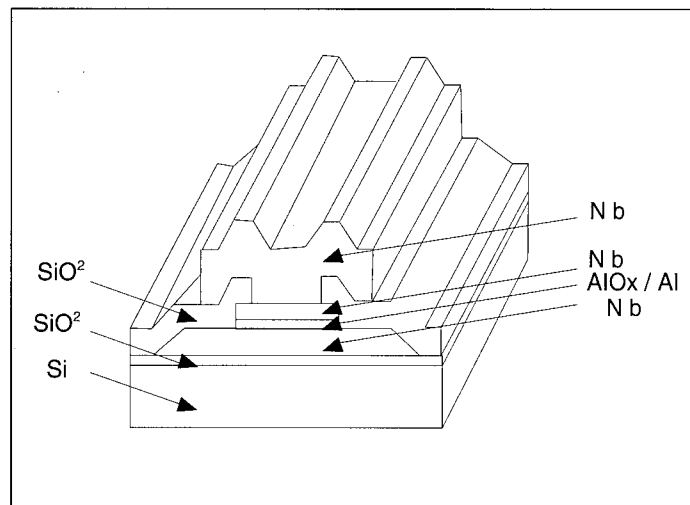


Fig. 3-5 Nb/AIOx-Al/Nb Tunnel Junction

Utilizing superconductance devices for the detection of fluorescent X-ray beams will considerably improve the statistical accuracies of collected charges compared with existing Si semiconductor detectors, and it is anticipated that the energy resolution will be improved to below 10 eV with respect to that of 130 eV (at 6 keV) of semiconductor detectors. This will be equivalent to decreasing the background noise by about a hundred times, and enable analysis on the ppb level compared with the existing analysis on the ppm level. Fig. 3-4 shows the conceptual diagram of this measurement system.

For example, when fabricating a superconductance detection device with an Nb/AIOx-Al/Nb tunnel junction (see Fig. 3-5), it will be necessary to considerably improve the efficiency of collecting quasiparticles generated inside the Nb film. Monocrystallization of the Nb thin films will be indispensable, making it necessary to establish the growth conditions. In this case, controlling the surface boundary structures of the wafer material and Nb film will be vital, for which evaluation of the surface boundary between the Nb thin film and substrate will enable clarification of the correlation between film material and device performance.

In concert with decreasing the noises of detection devices, the noise reduction of counter circuits will also become indispensable. The SQUID preamp is anticipated to permit ultrahigh-speed, low-noise counting. Further, a digital counter circuit (DSP) can be used in addition to the SQUID preamp to improve the S/N ratio by about a hundred times which, when used in combination with the superconductance detector, will enable  $\mu\text{m}$ -level analysis on the ppb level.

# ISO 9000 Specifications Assessment and Accreditation

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## 1. Introduction

The ISO 9000 Series Specifications are Quality Control and Quality Warranty specifications endorsed in 1987 by the International Organization for Standardization (ISO). At that time, the European Community (EC) had established the world's largest market among the major economies such as Japan and the United States, eliminated commercial obstacles within the market and aimed to reactivate and promote the progress of regional economic activities. In implementing the system (1993), the governmental organizations and enterprises of the EC countries (12 countries) adopted the ISO 9000 Series Specifications as the standards for evaluating the quality warranty capabilities of the manufacturers and suppliers of products and services within the community, and prescribed the recognition of this capability as the conditions for engaging in domestic and foreign transactions in the community by third-party organizations. Therefore, Japanese industries exporting to these countries, especially enterprises engaged in the manufacture of electronic components and office equipment, have been faced with what may be regarded as an intelligence obstacle, and these specifications became the essential conditions for acquiring recognition as endorsed enterprises. However, as observed from the entire Japanese industrial world, the issue was initially considered as a matter limited to enterprises engaged in exports to Europe. Therefore, the recognition of the ISO 9000 Series Specifications had been regarded as a passport for export. This is because Japanese enterprises had instituted total quality control (TQC) managements founded on quality control based on the traditional TQC methodology, so difficulties were encountered in understanding the propriety and necessity of accepting the system of assessing and supervising quality control systems by the regulations (not laws) of some third organization.

In Japan, the JIS Z 9900 Series Specifications were published as the translated regulations of the ISO 9000 Series Specifications in October 1991. To promote the establishment of a setup for an assessment and registration system based on the ISO 9000 Series Specifications and to promote the system substantiation and widespread adoption, the groups and organizations comprising the Japan Federation of Economic Organizations, subsequent to discussions over about one year, disbursed its own funds and established the Japan Accreditation Board for Quality Systems (JAB) in November 1993. This foundation was established to promote the application of the

assessment and registration system into various domestic industrial and economic circles. JAB revised its articles of association in June 1996 and expanded its fields of activities, changed its name to The Japan Accreditation Board for Conformity Assessment (JAB) and began accreditation work not only in connection with quality systems but also over a wide range of fields including environmental control systems.

The application of the ISO 9000 Series Specifications as the standards of procurement and transactions in products and services has undergone considerable progress internationally in the various sectors. In the United States, the big three automobile makers (Ford, Chrysler and General Motors) and the truck industry are requiring parts and material suppliers to acquire accreditation based on the QS 9000 specifications based on the ISO 9000 Series Specifications. Also, as a condition for engaging in tenders for public works projects in Southeast Asian countries, the ISO 9000 Series Specifications were introduced from about 1996. In Japan, based on a report by a joint committee relating to quality assurance in joint public works products by the three ministries related to construction, transportation and agriculture, the Ministry of Construction first implemented a pilot project that involved the application of the ISO 9000 Series Specifications in 1997, and announced that these specifications would be made a condition for engaging in tenders for public works projects larger than a fixed scale beyond the year 2000.

The increase in the number of industries striving to introduce the ISO 9000 Series Specifications may be regarded as satisfying the conditions for exports in the first wave, and procurements and transactions in the second wave. However, enterprises have also reassessed quality control setups and introduced quality systems based on the ISO 9000 Series Specifications as means for corporate restructuring, and there is a growing trend to accept accreditation from assessment and accreditation organizations, so Japanese enterprises can be recognized for their coordination of ISO 9000 Series Specifications and TQC, TQC restructuring based on the ISO 9000 Series Specifications, and progress into TQM, which may be regarded as a reemergence on the international market.

## 2. Domestic and Foreign Trends in the Acquisition of Accreditation

(1) A survey of international acquisition of accreditation by ISO 9000 S by Mobile Survey Co. in various countries worldwide was published in Volume 5, Num-

## ISO 9000 Specifications Assessment and Accreditation

ber 9 of Quality Systems Update Magazine. The results are listed together with the report announced the preceding year, to enable the course of the trend to be studied in comparison with the situation as of March 1995 (see Table 1).

### Number of Accreditations Worldwide

	Sept '93	Jun '94	Mar '95	Dec '95
Europe Total	37,779	55,400	71,917	92,610
Austria	200	434	667	1,133
Belgium	464	870	1,226	1,716
Bulgaria			1	3
Croatia		2	8	22
Cyprus	1	5	5	7
Czechoslovakia	18	47	101	180
Denmark	608	916	1,183	1,314
Estonia		1	1	1
Finland	324	496	646	772
France	1,586	3,359	4,277	5,535
Germany	1,534	3,470	5,875	10,236
Gibraltar		2	3	4
Greece	46	90	162	248
Hungary	23	58	125	309
Iceland	3	4	4	12
Ireland	893	1,132	1,410	1,617
Italy	864	2,008	3,146	4,814
Liechtenstein		14	14	19
Lithuania				2
Luxembourg	10	21	40	48
Macedonia				1
Malta	1	3	7	12
Monaco	1	2	5	5
Holland	1,502	2,718	4,198	5,284
Norway	172	400	679	890
Poland	1	16	41	130
Portugal	85	181	257	389
Rumania		6	15	42
Russia	5	8	15	22
Slovakia	5	11	27	59
Slovenia	16	43	62	99
Spain	320	586	942	1,492
Sweden	365	618	871	1,095
Switzerland	569	945	1,520	2,065
Turkey	65	106	270	434
Ukraine	1	4	7	8
Yugoslavia	1	1	0	0
United Kingdom	28,096	36,823	44,107	52,591

### Pan Pacific Total

	4,767	7,719	12,458	19,766
Brunei	2	3	5	17
China	35	150	285	507
Fiji			1	1
Hong Kong	161	336	551	739
Indonesia	8	22	55	125
Japan	434	1,060	1,827	3,762
Malaysia	224	258	628	690
Philippines	4	13	79	102
Singapore	523	662	1,003	1,180
Korea	87	226	390	619
Taiwan	96	337	1,060	1,354
Thailand	9	24	95	143
Vietnam				1
Australia	2,695	3,710	5,299	8,834
New Zealand	489	918	1,180	1,692

### North and South America Total

	Sept '93	Jun '94	Mar '95	Dec '95
Brazil	113	384	548	923
Chile		9	11	21
Colombia	6	23	51	49
Mexico	24	85	145	215
Canada	530	870	1,290	1,397
United States	2,059	3,960	5,954	8,762

### Africa/West Asia Total

	1,411	2,061	2,877	3,378
India	73	328	585	1,023
Israel	170	279	497	526
Saudi Arabia	10	30	53	98
South Africa	1,146	1,367	1,627	1,454

### Other Regions

	109	36
Total Number Worldwide	46,702	70,544
Number of Countries	60	76

Table 1

Source: Mobile Survey of ISO 9000 Accreditations and Environmental Preservation Accreditations

The total number of cases was over 100,000 in 1995, and in 1997, as judged from the acquisitions in the United States, Britain and Japan, the number was estimated to exceed 150,000 cases and probably about 200,000 cases.

### (2) Trends in Accreditation Acquisition in Japan

At present, there are about 30 organizations engaged in accreditation in Japan, including those which are not recognized formally, and the total number of accreditation cases reported by these organizations was about 5,300 in June 1997.

Fig. 1 shows the trends in the number of cases of ISO 9000 S registration in Japan beyond 1990, Fig. 2 the constituent ratio of applied specifications, or the aggregate numbers during 1990-1997, and Fig. 3 the aggregate industrial constituent ratio of accredited enterprises, as compiled from the statistics of the Japan Quality Assurance Organization. Fig. 4 indicates the state of applications by industries during the period from December 1996 to 1997, which gives aggregate figures of electrical machinery (54%), chemical (12%), and machinery (11.8%), indicating that the ratio is overwhelmingly high among export-related industries. However, more recently, advances in applications are being made by the information processing, construction, plastics, services and physical distribution industries.

## 3. Accreditation System and the Activities of Accreditation Organizations

### (1) Approval Organizations and Accreditation Organizations



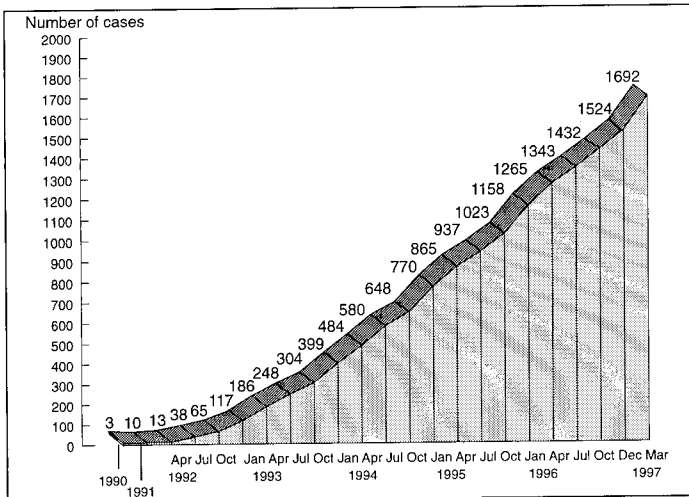


Fig 1 Number of ISO 9000 accreditations registered by JQA

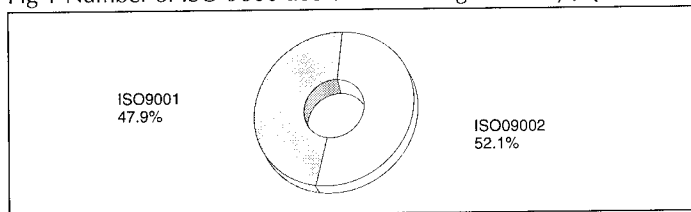


Fig 2 Constituent ratios of applied specifications

ISO 9000 S are civilian basis international specifications endorsed with the agreement by the representative organizations of various countries in the International Standardization Organization, so there are no special laws to govern the establishment and advancement of business activities of the accreditation organizations conforming to the established regulations. As long as these organizations can meet the needs of enterprises desiring to acquire accreditation, various types of organizations can

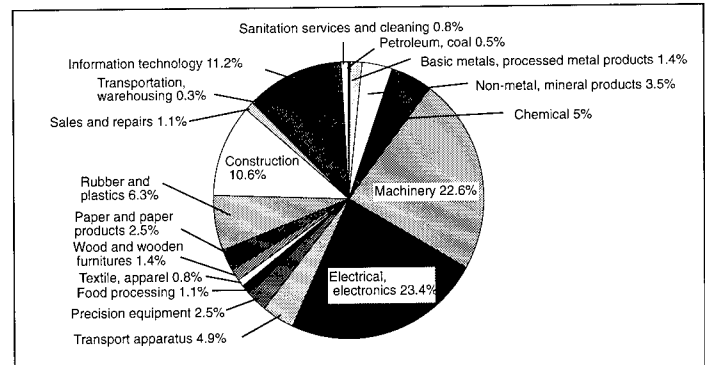
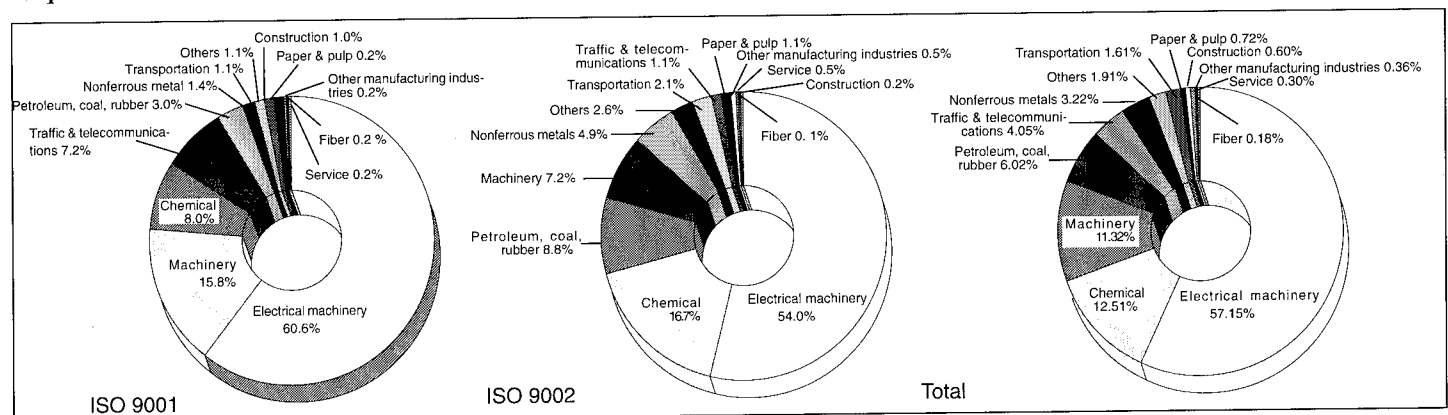


Fig 4 Accredited products

be registered regardless of their scale, type of industry or business background. However, to prevent problems arising from the differences in the accreditation contents and capability levels of these accreditation organizations, various countries have introduced their qualification systems to determine accreditation organizations, and in Japan the accreditation organization JAB has been established.

As of the end of 1997, a total of 23 enterprises have been registered as accredited organizations by JAB. Accreditation organizations study the applications submitted from among the 39 accreditation classifications, and JAB indicates the fields which are recognized. The preamble of the ISO 9000 Series Specifications states that these specifications are applicable to all types of industries and economic activities, but does not necessarily state that the recognized accreditation organizations do actually possess the accreditation capacity with respect to all industrial fields.

JAB approval operations engage in the approval of accreditors which are the mainstays for implementing or-



## ISO 9000 Specifications Assessment and Accreditation

ganization accreditation operations, as well as in the approval of the training organizations for culturing accreditors. As of the end of January 1998, the total number of accreditors approved was 2,590 (managerial accreditors: 616, accreditors: 397 and assistant accreditors: 1,557),

Various countries have in principle a single accreditation organization: ANSI-RAB in the United States, COFRAC in France, UKAS in Britain, TGA in Germany, RvA in Holland, JAS-ANZ in Australia and New Zealand, and KAB in Korea.

### 2) Recognition of Accreditation and Certification Systems Based on ISO 9000 Specifications

#### 1 \* Trends in Accreditation Organizations

Internationally, the organizations engaged in the promotion of the recognition of the quality system accreditation system based on the ISO 9000 S are the Quality System Assessment Recognition (QSAR) Organization established in 1992 by the ISO Board of Directors and the International Accreditation Forum (IAF).

IAF is a deliberative organization established in January 1993 as a accreditation organization of the world's leading countries. Its objectives are to exchange information and opinions on the accreditation organization level for establishing a mutual accreditation setup, and JAB is a participant. Studies are being given to guidelines as in connection with the procedures for mutual evaluation and for matching the assessment procedures to support the activities of the ISO/CASCO Compatibility Evaluation Committee. The issues under study include not only the quality system and the environment management system but encompass a wide range of compatibility affirmation such as the approval of testing stations. In January 1998, IAF concluded an agreement on the mutual accreditation of quality systems with 17 countries and 16 organizations, by which the international accreditation system started moving in the sector of recognition and accreditation of the ISO 9000 Series Specifications. As a result, the accreditation organizations of JAB (Japan) and RvA (Holland), for example, which reached the agreement, are responsible for the logos of the partner accredited organizations. IAF is making preparations to establish a corporate body during 1998, and QSAR business operations are conceived to be advanced in the direction of coordination by IAF.

#### 2 \* Trends in Certification Organizations

The International Certification Network (IQNet) that was established primarily for Europe is the organiza-

tion for mutual cooperation and recognition of assessment and recognition of assessment and recognition organizations based on ISO 9000. IQNet was established in 1990 under the non-profit third person recognition system that is the representative status in Europe countries, and its objectives are to coordinate approval methods and assessment procedures, offer regulation definitions, establish accreditor standards, determine assessment charge among members, promote coordination between members, and promote recognition between member countries.

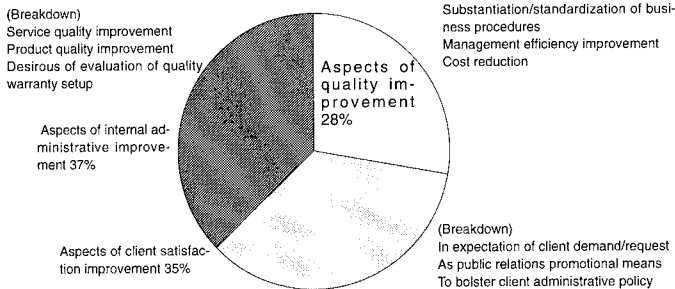
In Japan, the Japan Quality Assurance Organization had been participating as an observer, but was recognized as a formal member in June 1995, and with the further participation of Australia, the network was bolstered into a powerful network not limited to the European region. Including the European assessment organizations, As of August 1997, there were 25 organizational members including the British BSI, German DQS, French AFAQ, Dutch KEMA and Belgian AIB-VINCOTTE. IQNet members are allowed to issue approval certificates inscribing the IQNet logo mark, and due to agreement, registration certificates of member participating countries are issued to applicant enterprises without duplicate assessment based on the approvals by members of the accord. In addition, another IQNet objective is to engage in cooperation and mutual recognition with ISO 9000 in connection with environmental control systems based on ISO 14001 and labor & sanitation control systems.

### 4. Acceptance of Assessment and Recognition System by Enterprises

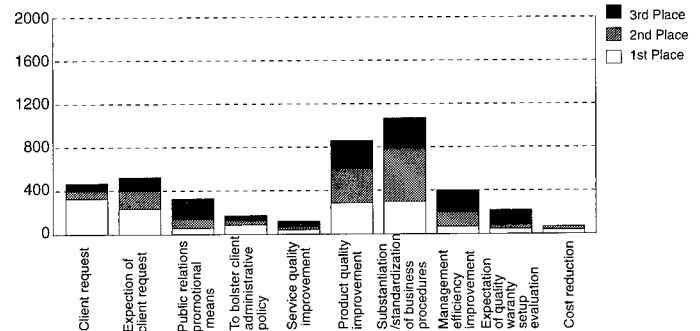
Fig. 5 shows a part of the report of an questionnaire survey conducted by the Quality Assurance Research Institute of roughly 1,000 enterprises having acquired the accreditation certificate, to assess attitudes regard their motives for acquiring the accreditation and the effect of the acquisition.

Regarding Q1 on their motives for acquisition of accreditation, it appears that the quality system restructuring element including business bolstering and standardization as well as quality improvement far surpass the client demand, but when considering that quality improvement consists of a considerable number of duplicated replies, the overall observation is that externally-oriented reasons and internally-oriented reasons are generally balanced. Naturally, this will differ with the type

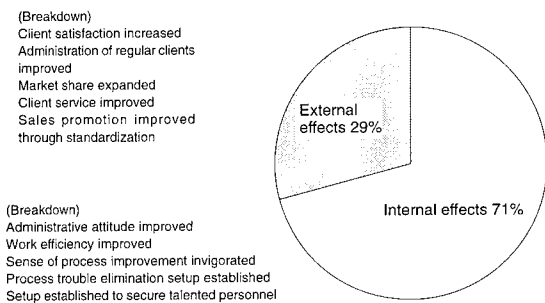
## 1. Motive for Accreditation Acquisition



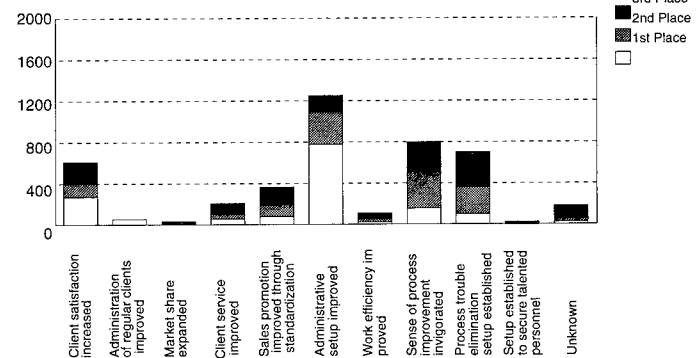
Aggregate Number of Cases



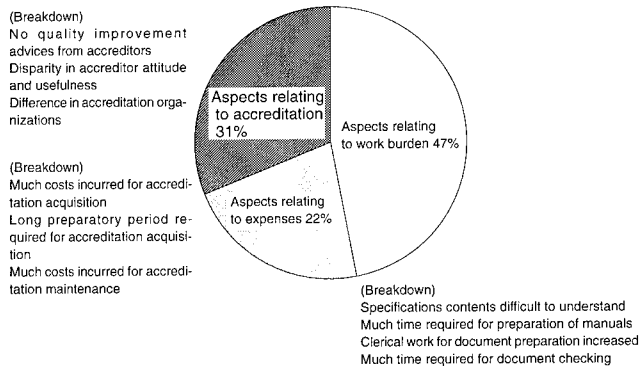
## 2. Effects of Accreditation Acquisition



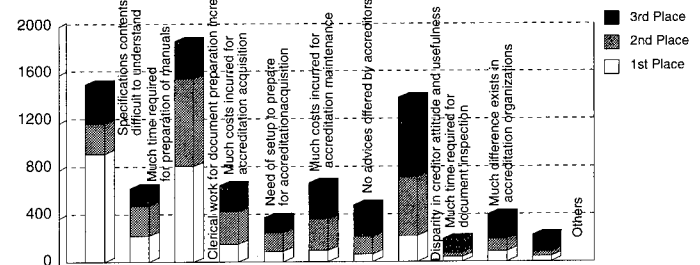
Aggregate Number of Cases



## 3. Problems Relating to Accreditation Acquisition



Aggregate Number of Cases



(The classifications of 1st place, 2nd place and 3rd place in the graph are based on the degrees of impressions sensed in connection with the motives, effects and problems of each item.)

Fig 5

of business and corporate scale, but considering that the system introduction in the initial stage was oriented toward the EU region, the ISO 9000 S is now evaluated higher than before as a means for self-imposed corporate restructuring.

The replies of management setup bolstering and establishment of process improvement setup offered as the results of accreditation acquisition in Q2 indicate the effects of applying management administrative methods based on quality system establishment in conformance with ISO 9000 S. Improvement of client sat-

isfaction assumes a prominent position, which reflects an attitude to respond better to client needs and the ensuing improved results, which deserves attention.

Regarding the matter of Q3 of accreditation acquisition, the problems relating to document preparation work and regulations difficulty both account for about 50% of replies. According to a survey conducted separately, there were many enterprises which pointed out the merit of clarification of the administrative setup though documentation, so expectations are placed on effective implementation and operation.

## ISO 9000 Specifications Assessment and Accreditation

### 5. Recent Topics Regarding ISO 9000

(1) Moves in Various Industrial Circles

1) Automotive Industry: QS 9000 Specifications of Big Three

\* Course of Endorsement and Issuance of QS9000 Specifications

In 1988, the big three US automotive corporations of Chrysler, Ford and General Motors established a task force to standardize quality demands with respect to the suppliers of automotive parts and materials, and issued the QS 9000 Specifications prescribing their Quality System Assessment (QSA) and Quality System Requirement (QSR) programs via the Automotive Industry Action Group (AIAG). The QS 9000 Specifications defined 20 quality demand items prescribed by ISO 9001 (1994 version) and demand standards which are harmonized with the unique standards of each enterprise. As a result, the big three eliminated the problems arising from the differences in the documents and procedures, set coordinated standards and aimed to expand the procurement of parts and materials from enterprises other than the existing transaction partners.

The big three set a limit time for the primary suppliers to register with the third person organization (after which only recognized enterprisers would possess the delivery qualifications), with Chrysler setting the limit at the end of July 1997, General Motors at the end of December 1997 (Ford demanded no third-person registration as of the end of 1996: self-evaluation possible). However, in Japan, the number of registered domestic enterprises increased rapidly from 1997, and as of the end of November the number was about 60 enterprises.

2) Moves in the Construction Industry

The construction industry engages in the construction of multistory buildings, and advances work by integrating small-scale contractors. The business is rather fluid and the construction sites change from time to time, so the industry had been quite wary about introducing and enforcing system controls based on ISO 9000. However, more recently, in the process of engaging in tenders successively in Southeast Asian countries which involve ISO 9000 S, Hong Kong obligated contractors to acquire ISO 9000 S accreditation beyond October 1996 and Singapore beyond July 1999, and to conform to this need, domestic general contractors as well as their overseas business departments and affiliated contractors accelerated moves to acquire accreditation from local assessment and accreditation organizations as well

as from the foreign accreditation organizations maintaining networks in Japan, so that the overseas representatives of leading Japanese general contractors have already acquired accreditation.

Meanwhile, in Japan, the Ministry of Construction established a committee consisting of related experts in the direction of adopting the ISO 9000 S to establish its conditions for contractors to participate in its public works projects with scales exceeding a fixed level by the year 2000, drafted guidelines for the application of the ISO 9000 S to the sector of construction, and is conducting pilot projects relating to various fields such as roads, bridges and buildings as well as in various regions beyond 1996 with the objective of studying the methods of applying quality control methods based on ISO 9000S, establishing specific procedures, assessing the contents, sounding out related problems and establishing measures to cope with these matters.

3) ISO 9000 S for Procurer (2nd Person) Surveillance

As pointed out earlier in the Introduction, Nippon Telegraph & Telephone Public Corporation (NTT) announced in August 1995 a new quality control setup for product procurements called NQAS and introduced the ISO 9000 Series Specifications. The NQAS system is used by NTT for quality system assessment of manufacturers, and consists of quality system demand items comprised of ISO 9001 Specifications and specific items designated by NTT. In addition, improper information is analyzed from the applied product field, the items to be checked in the quality systems of manufacturers are selected and improved to link these items to product quality warranty.

(2) Future Outlook of ISO 9000 Specifications

The ISO 9000 Specifications are being reassessed (revised) once every five years, and the first revision was in 1994 (initial version published in 1987). The ISO Quality System Specifications Committee (TC 176) proposed revision of ISO 9000 S in two stages at a meeting held in 1990. The establishment of a working group was studied, and the program in the first stage was to meet short-term needs without making changes in the structure or numbers (enforced in 1994), and in the second stage the idea was to conduct alterations based on Vision 2000 set by TC 176.

The issues to be resolved into the future are how to apply each specification to small, medium-sized and large enterprises, how to apply these specifications to enterprise engaged solely in manufacture or solely in design,

how to resolve the matter of quality warranty with respect to end users, how to introduce the TQM technique, and how to determine the contents to enable the specifications to be applied to the product categories of hardware, software, services, processes and materials.

In the ISO TC 176/SC2 committee meetings, the ISO 9000 family revision work was started with the schedule of publishing the results in February of the year 2000, but since various problems are being encountered, such as the need for making adjustments with ISO 14000, coordination of the compound specifications (ISO 9001/9002/9003), and coordination of the degrees of alterations to be made on the specifications which have come into wide use on a global scale as well as the propriety of the contents. Therefore, it will be necessary to carefully follow up the future schedule.

### (3) Simultaneous (Composite) Assessment of ISO 9000 and ISO 14000 Specifications

The ISO 9000 Series Specifications began as quality system specifications in corporate management, and in the industrial world underwent epochal international application together with the third person assessment system. Meanwhile, the ISO 14000 Series Specifications were issued in 1996 as the environmental version of corporate management systems, and especially in Europe and Japan, they have been accepted widely and rapidly as a corporate means for image appeal to cope with global environmental preservation issues systematically under a planned format.

The ISO 9000 S and ISO 14000 S, as management control system specifications, have many common demand items, and the ISO 14001 appendix also indicates items which are correlated with the two previous specifications. Some assessment and accreditation organizations are gradually starting the operations of simultaneously performing accreditation assessment and regular assessment (follow-up subsequent to registration) in response to the desires of enterprises and organizations striving to acquire accreditations in connection with both specifications.

The merits of simultaneous (composite) assessment may be summarized as follows:

(1) Establishment of a base to derive added effects of both management systems within a corporation.

(2) Decreased number of processes for assessment and accreditation.

(3) Decreased number of assessments simplifying administrative tasks and reduced related costs.

## 6. Summary

The ISO 9000 Series Specifications were introduced as quality control version corporate management system specifications and are undergoing epoch-making widespread use as international specifications. The ISO 14000 Series Specifications which were issued in 1996 are also attracting increasing attention as environmentally-oriented version system specifications, as a means for industry to make cleanliness-oriented appeals as enterprises friendly to the earth, and appears to be gaining self-implied recognition as an environmental administration promotional measure for regional autonomous entities responsible for administrative management.

The recent trend in the popularization of the ISO 9000 S is to shift from large enterprises to small- and medium-scale enterprises, and from the manufacturing industry to the service industry. The acquisition of accreditation by leading electrical machinery, general machinery and chemical enterprises has about attained the peak, and is now proceeding into the sectors of related enterprises as well as contracting and transacting enterprises. Meanwhile, great interest is being shown by the information processing, telecommunications, transportation, physical distribution, medical treatment & welfare, construction and public works industries, also by regional autonomous entities and commercial banks.

Internationally, widespread utilization is considerable among European countries, especially in Britain, and more recently the acquisition of accreditation is increasing rapidly in a wide range of industrial sectors in the United States, primarily manufacturing industry, but when compared from the aspect of industrial scale, the number of acquisitions of accreditation by Japanese enterprises is relatively few. The International Standardization Organization specifications were devised and issued with the basic objective of use as the ideal standards for international transactions, but the situation in Japan is that there is a larger number of enterprises which unilaterally acquire accreditation as a means to restructure their own corporate management systems rather than acquiring accreditation as a means of conforming to client preferences.

Only a few years have elapsed since the accreditation system based on the ISO specifications was established. It is presently being applied to all types of industries and organizations, and endorsed and implemented with the objective of promoting related activities. It is anticipated that the system will achieve sound progress into the future through close international cooperation.

# NEW TECHNOLOGY & PRODUCTS

*This section provides information about recently developed technologies and products, divided into Advanced Materials, Electronics & Optics, Information & Communications, Process & Production Engineering, Construction & Transportation, Energy, Environment, and Biotechnology & Medical Science.*

## Advanced Materials

98-03-001-01

### **Ceramic Pellets with Antibacterial and Water Quality Improvement Effects**

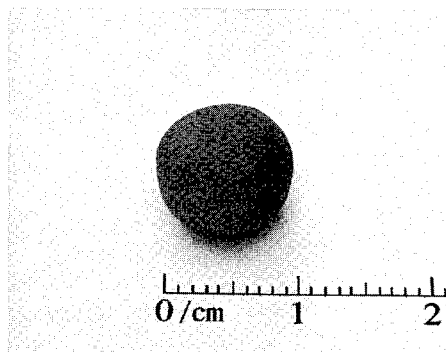
Seeon Co., Ltd. and Tetsuya Kochi, Environmental Preservation Laboratory Co., Ltd. have jointly developed a ceramic pellet "Mirathrough Z" with a diameter of 10 mm and weighing 1 gram that kills bacteria in water and improves the quality of faucet water.

When 10 pieces of these ceramic pellets were immersed in 500 ml of fresh water and the sterilization effect of the pellets was investigated, it was found that colitis bacteria O-157 causing intestinal tract bleeding were decreased in five minutes down to 26.9% (initial number 17,000,000) and in 20 minutes to 18.5%, and that in 24 hours the number of bacteria of over a million and a half was drastically decreased down to only a dozen.

The new ceramic pellet is composed of calcium carbonate and a small quantity of nonferrous metals. Tests using other ceramic pellets not containing these substances showed that in 24 hours the number of O-157 colitis bacteria was decreased to about 58% but that other types of bacteria remained active in the water. Also, the number of other types of bacteria rather increased.

The company observes that the sterilization effect of this new product is due to the rapid lowering of the water potential. Potential lowering exerts adverse influences on microorganisms, but as water particles, which in turn change the osmotic

pressure, kill the microorganisms. City tap water generally has a high potential, but the famous natural waters available in various regions have a lower potential without exception, so the ceramic pellet is antici-



Mirathrough Z

pate to display an excellent water quality improvement effect.

The new ceramic pellet displays its sterilization effect in still water at room temperature without having to boil or to add any chemicals, so the company anticipates that it can be added into cold or room temperature washing and immersion water used for fresh food rinsing and in food processing to prevent proliferation of O-157 colitis bacteria that caused an epidemic of bleeding of the intestinal tract in the summer of 1996, and to prevent lung ailments in homes caused by legionella pneumophilla through bathing in the same water left undrained for over 24 hours, and especially for preventing infections inside hospitals caused by Staphylococcus aureus.

\* **Seeon Co., Ltd.**

Honmochi, Kono Build. 5F, 3-2-14,  
Azuchimachi, Chuo-ku, Osaka 541-0052  
Tel: +81-6-264-6851  
Fax: +81-6-264-6865

## Electronics & Optics

98-03-002-01

### **Cream Solder Printing Machine with Image Recognition Function**

Mitani Electronics Corp. has developed a cream solder printing machine MM-CL75 for working with wafers for high density mounting of 0.3-mm QFP and 1005 chips as well as various types of wafers which must feature extra-density and high-precision machining.

The printing machine was developed in response to user needs by applying the plate-making technology, and features excellent machining accuracy and productiv-

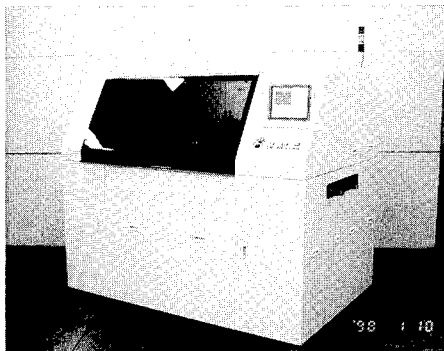
ity due to the incorporation of an image recognition system and an automatic cleaning system. The machine is marketed at a domestic price of ¥18 million.

The method of mounting electronic components on printed circuit wafers is in wide use today as a surface mounting technology with the commercialization of ultracompact and lightweight portable telephone units, and the cream solder screen printing technique fully responds to the existing trend. Meanwhile, printing machine manufacturers are required to develop high-performance printing machines



Printing area	Min. 50(W) × 70(L) mm - Max. 330(W) × 450(L) mm
Wafer thickness	Min. 0.8 mm - max. 2.0 mm
Screen frame	650 mm × 750 mm (550 × 600, 550 × 650) interchangeable
Repetitive accuracy	Max ±0.02 mm
Printing system	Single, double, pass (3 modes)
Camera unit	CCD camera for 4-point simultaneous recognition
Wafer fixation system	Clamp fixation and vacuum suction used in combination
Cleaning system	Vacuum adsorption and scraping system
Plate separation mechanism	Automatic setting
Pass line	900 mm ±20 mm
Transfer direction	Right → left (standard)
Printing cycle	30 sec/sheet
Display input	Fingertip touch panel
Control system	Microcomputer controlled
Air	5 kg/cm <sup>2</sup> (clean air)
Power source	3-phase, 200 V
Machine size	1,800(W) × 1,160(D) × 1,530(H) mm
Conveyor length	1,980 mm
Weight	1,300 kg

New Printing Machine Basic Specifications



MM-CL75

featuring better machining accuracies for incorporation into fully automated production lines.

The primary requirement of printing machines used in fully automated production lines is performance stability, so the company designed the new printing machine with an excellent plate making performance by introducing unique, advanced ancillary facilities such as an image recognition system, a plate separation mechanism and an automatic cleaning system, which succeeded in developing a maintenance-free printing machine available in a large size.

The company is marketing various types of screen printing machines, and plans to differentiate its products from those of its competitors based on the advanced plate-making technology expertise acquired through years of supply of precision metal masks (plates).

**\* Mitani Electronics Corp.**

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Tokyo 206-0025  
Tel: +81-423-37-1411  
Fax: +81-423-37-1519

98-03-002-02

## Graphic Controller Compatible with New Information-Processing Home Electronic Equipment

Yamaha Corp. has developed an LSI YGV618 (AVDP5) for image display that incorporates a flicker cancelling function and which is applicable to information-processing home electronic equipment such as data broadcasting-compatible TV units and Internet TV units.

The graphic controller was developed because new products are emerging against the backdrop of the Internet boom, such as the Internet TV set to meet the growing

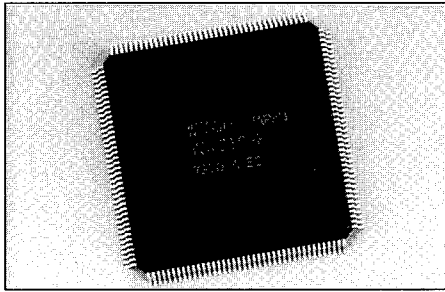
need to observe home pages (WWW) with home TV units. Both the Home Page and data broadcasting services for television will be put into service from April 1998, so the reception of information will undergo diversification through home television. In concert, set-top boxes and other entirely new advanced information processing home electrical equipment will enter home use, and it will increasingly become necessary for home TV units to display fine characters on home TV units.

However, when home pages consisting largely of fine characters and lines are displayed on home TV units, the images will flicker and become difficult to see. This is because the monitors of personal computers adopt the non-interlaced display system of displaying all images by primary scanning, but the generic home TV set adopts the interlaced display system of displaying each image frame by scanning twice.

The YGV618 is an LSI that enables design of new information-processing home electronic equipment such as data broadcasting-compatible TV sets as well as Internet TV units and car navigation display systems by utilizing various image display and control functions. By incorporating a flicker cancelling filter, it will be possible to display home pages of minimal flicker even with interlaced type TV units, permit compatibility with the 16:9-ratio wide TV screens and enable display in 32,768 colors in VGA mode (640 × 480 dots), or to feature a multiplicity of functions. In addition, the frame buffer (image display memory) will become available at a lower cost, and enable compatibility with extended data output (EDO) type DRAMs of high data transfer speeds.

This LSI features a fast display capability for switching and using multiple image signals, and setting the monitor image resolution capability and vertical/horizontal synchronous frequencies flexibly, which are excellent basic functions necessary for graphic controllers. In addition, by incorporating a peripheral circuit for synchronization with external image signals, it will become possible to decrease the number of components and the system total cost.

YGV618 is an ideal graphic controller to control the image displays of information-processing home electronic equip-



YGV618

ment, so its development is expected to proceed on a full scale.

**\* Yamaha Corporation**

2-17-11, Takanawa, Minato-ku, Tokyo 108-8568

Tel: +81-3-5488-6601

Fax: +81-3-5488-5060

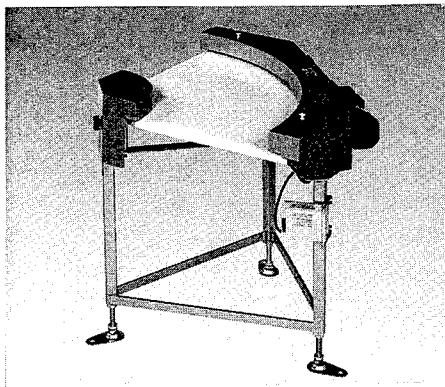
## Machinery & Mechatronics

98-03-003-01

### Curved Belt Conveyor to Convey Miniature Objects Reliably

Maruyasu Machinery Co., Ltd. has developed a curved belt conveyor Mini Belt Curve 3 that is based on an entirely new system for driving the peripheral parts of the belt.

Driving the peripheral parts enables the conveyor inversion at both terminals to be accomplished with a straight roller of small diameter to permit miniature workpieces,



Mini belt curve 3

for example, to be conveyed and shifted accurately. The conveyor is available in two types with an angle of 90 degrees or 45 degrees, and a width from 200 mm to 600 mm in 100-mm steps. It is available in a fixed speed or a variable speed version depending on the need, and is a low-noise type since a standard system is equipped with gear heads of hollow shaft. The domestic selling price is about 15% lower than that of a conventional type of conveyor of the same size.

The conventional type of curved conveyor, as with the straight conveyor, is gen-

erally driven with rollers installed on the side of the direction of advancement. However, the drive distance will differ at the belt peripheral sides and inner sides, making it necessary to use a tapered roller that is large on the peripheral side, so that the transfer distance will be greater on the peripheral side. As a result, when conveying small workpieces, an auxiliary roller may become necessary.

Minibelt Curve 3 belt peripheral parts are driven with a special type of feed mechanism, so it is possible to use a straight roller with a diameter of 20 mm specifically for inverting both terminals of the conveyor, which enables the transfer of even miniature workpieces very smoothly. At the same time, the number of parts such as the guide rollers is decreased considerably, by which the maintenance need is reduced and the conveyor system can be marketed at a lower price.

**\* Maruyasu Machinery Co., Ltd.**

2-11-6, Narita-cho, Okaya City, Nagano Pref 394-8540

Tel: +81-266-23-5630

Fax: +81-266-22-0935

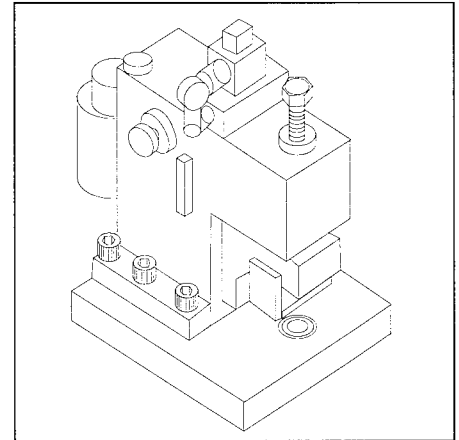
98-03-003-02

### Compact Hydraulic Press Generating No Burr

Imaizumi Daishin Co., Ltd. has marketed a compact precision punching press DMP-9711 that generates no burr even when working with thin steel sheets.

To eliminate backlash when punching, this press is designed to suppress the die common difference (meshing) to less than 50  $\mu$ m. It adopts the method of suppressing the die deflection with a support fixture and of pressing down the workpiece

with a spring mechanism, by which neat finishing is ensured without generating any burr on the punched surfaces. Also, it is usable for punching even boxed products, which is impossible with the conventional C-type press.



DMP-9711

The press has a punching capacity of 10 t and can work with steel plates of 0.1-5 mm thickness. The press has a breadth of 430 mm, depth of 660 mm and height of 560 mm. The compactness enables installation even in narrow worksites. It is sold at a domestic price of ¥500,000, and is ideal for use in the manufacture of data processing and communications equipment, also for use in research laboratories and universities.

**\* Imaizumi Daishin Co., Ltd.**

62-28, Koyamazuka, Oiwa-cho, Toyohashi City, Aichi Pref. 441-3131

Tel: +81-532-41-8282

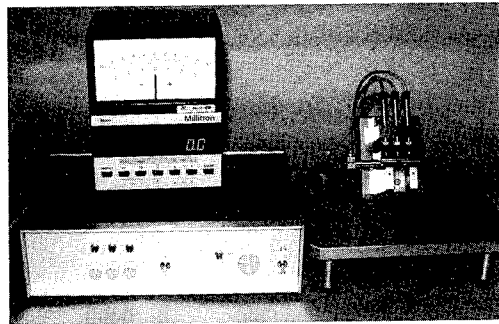
Fax: +81-532-41-8297

98-03-003-03

### Precision Shaft Measuring Apparatus

KK SEIKO E.M. Co., Ltd. has developed a precision shaft measuring apparatus Hakattaro GS that is essentially based on the principle of the differential transfer electronic micrometer and the measuring amp (millitron 1240 type) features a precision linearity of 0.01%. It can measure small ultraprecision shaft parts on the sub-micrometer level, and incorporates a program measuring and statistical arithmetic function.

The apparatus is usable not only for measuring the diameters of small ultraprecision parts such as hydraulic valve spools, fuel injection pump plungers and jet valve needles, but also for measuring

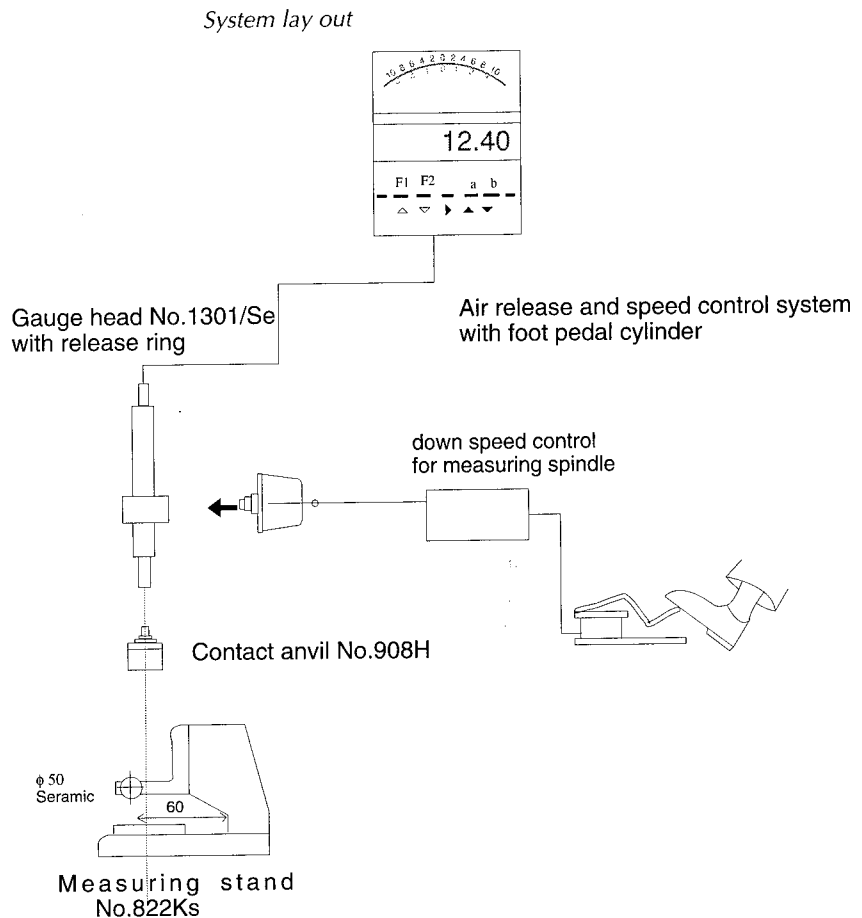


Electronic micrometer  
Millitron 1240

**Measuring range**  
+200 $\mu$ m  
+1000 $\mu$ m

**Resolution**  
0.01 $\mu$ m  
0.1 $\mu$ m

**Zero reset** by one touch switch  
**Out put** RS232C and analogue



the roundness, perpendicularity and cylindricity of various mechanical parts.

The measurement accuracy, when reading out on the sub-micrometer level, is within  $\pm 0.1 \mu\text{m}$ , and when reading out on a  $0.01 \mu\text{m}$  level, is within  $\pm 0.05 \mu\text{m}$ , and the results are displayed in both analog and digital readings. When measuring several types of target objects, several types of brackets fitted with a differential transfer gauge head are used which can be changed flexibly. The apparatus is also usable for conducting automatic measurements.

The company has been successively marketing its series of Hakattaro precision measuring apparatus, and the newly developed apparatus is marketed at a domestic price of about ¥2,500,000.

\* **KK SEIKO E.M. Co., Ltd.**

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Osaka 560-0875

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## Information & Communications

98-03-004-01

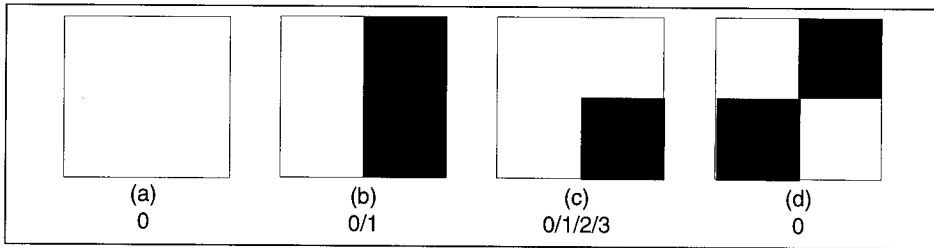
### Automatic Segmentation and Encoding of Image Regions —Major Progress in the International Standardization of Digital Image Coding—

The Communications Research Laboratory of the Ministry of Posts and Telecommunications, IBM Research, Tokyo Research Laboratory, have jointly established an effective method for region-based coding of still images that automatically enables figures, objects and other subjects to be extracted from still pictures and for separation from the background.

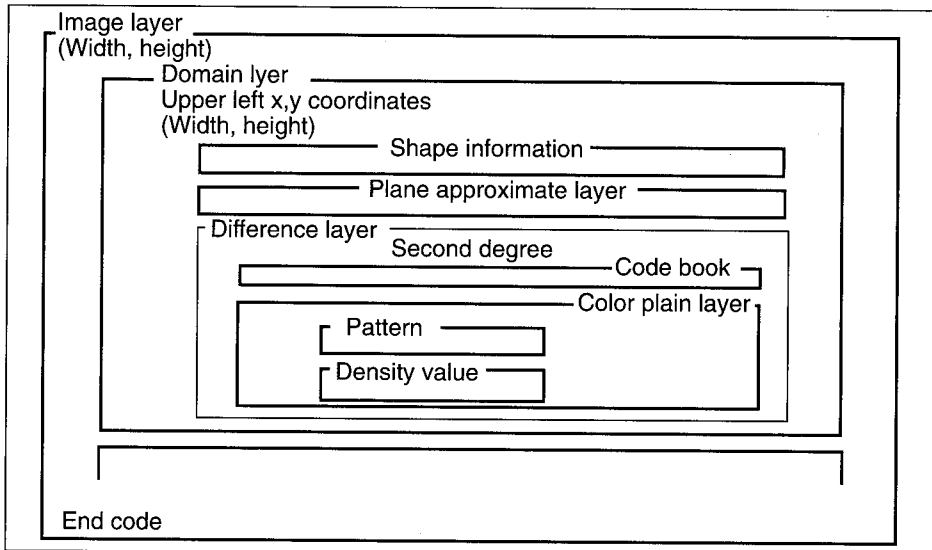
With this technology, regions in which the colors and brightness, or the texture change periodically are extracted and controlled as image components. In the future, this technology is expected to contribute to the international standardization

of the video coding generation of image compression technology MPEG-7 that emphasizes contents processing. Previously, images were handled in the unit of frames, so unless the contents were defined, image processing had been quite difficult. In most cases, the subjects of extraction are specific objects (for example, a person, car, or background) shown in a picture, and successful extraction depended largely on human selection of the content. Further, use of the extracted results for synthesis, or to alter a portion of the image, required careful manual extraction of the desired region.

The newly developed technology has a wide range of applications from the composition of animations consisting of simple coloration to the composition of natural scenery pictures including complicated textures. The analogy of colors and textures is utilized, and the method of segmenta-



Allotment of patterns into fine domains



Data construction

tion is achieved by using a probability model. The extracted regions are described as simple approximate images and in the residual of the original image. Repeating the compression of this residual data will express the residual data hierarchially, and ultimately, encoded data will be obtained allowing regeneration of an image exactly the same as the original image (lossless compression). The image will differ with the user, so by designating the residual hierarchy, it will be possible to select the required image quality and data volume.

Utilizing this technology will enable the parts of an image to be retrieved by designating the region shape, color and texture, even without specifying the image, so enabling retrieval based on the contents. Also, since regions can be handled independently, region transfer or synthesis will be easier, and a preview image using a small volume of data or a complete image can be displayed based on the same image file.

Examples of the application of this technology include image retrieval at a digital library, image transfer through transmission methods where the communications capacity is limited, such as the Internet, and sup-

port of creators who provide added values to images.

**\* IBM Research, Tokyo Research Laboratory**  
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98-03-004-02

## Non-Contact Type High-Speed Three-Dimensional Digitizing System

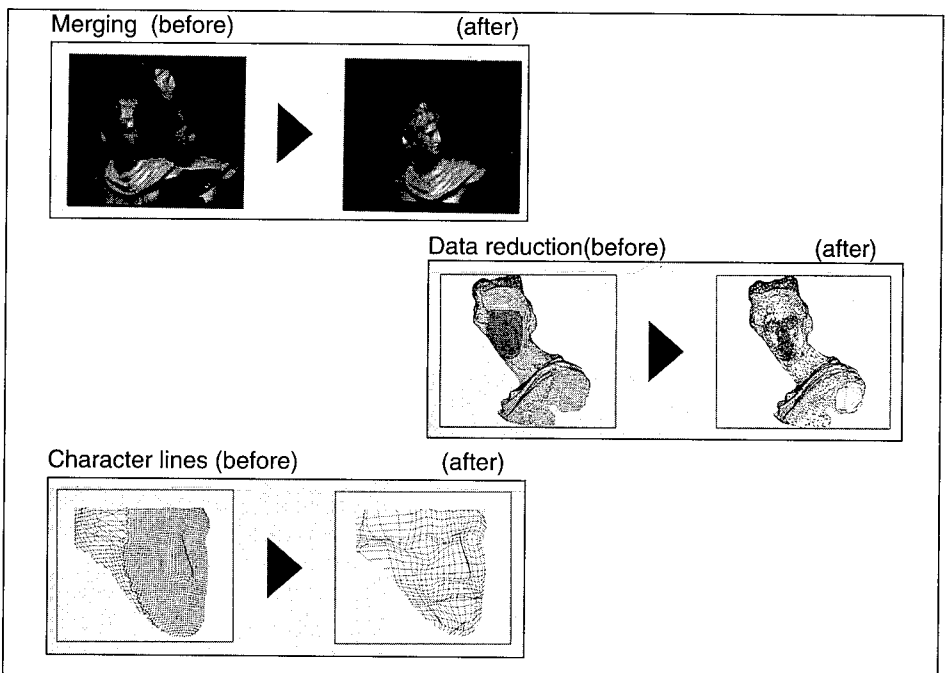
Minolta Co., Ltd. has developed a non-contact type high-speed three-dimensional digitizer for inputting computer graphics (CG) target images with a laser system which is available at a low cost of about ¥3,000,000.

The non-contact type three-dimensional digitizer VIVID700 scans the target object with a laser beam and captures the reflected light with a charge-coupled device (CCD). The distance between the target object is measured by the principle of triangulation and 3D data is input into the work station. The use of the color CCD enables input of the color image.

The rotary table sold as an optional accessory may be used to revolve the target object and scan with ease. The utility software is provided as a standard accessory which enables input data processing or to export the images into other CG software formats.

**\* Minolta Co., Ltd.**

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Utility software

## Process & Production Engineering

98-03-005-01

### Manufacture of Artificial and Synthetic Leathers Using No Organic Solvent

Koatsu Cloth Co., Ltd. has established a technology to manufacture artificial leather and synthetic leather without using any organic solvent. The new technology is anticipated to provide immense effects for environmental improvement, and reduces the manufacturing time and necessary energy to less than one-half compared with conventional processes, so it is expected to decrease the emission of carbon dioxide (CO<sub>2</sub>) gas generated in the manufacturing process. The company plans to gradually establish a production setup and to develop a unique leather market with its Allitus brand leathers.

Normally, artificial leather (made of nonwoven fabric) and synthetic leather (made of nonwoven fabric) are manufactured by coating a solvent-polymerized type polyurethane resin, but since dimethyl formamide (DMF) is used, the process may have adverse influences on the human body and surrounding environments. The introduction of a closed process to cope with the situation is expected to involve enormous costs.

Allitus is a water-based medium, coupled with an application of a non-toxic polyurethane emulsion. It employs no hazardous oil, solvent or chemical in its manufacturing processes. A technique was established to produce a base material featuring density and excellent strength by using an aqueous polyurethane and the surface film layer of solvent-polymerized type polyurethane was switched to an aqueous type to completely eliminate the use of organic solvent in the manufacturing process. There is also the advantage that no dimethyl formamide (DMF) is emitted into the atmosphere.

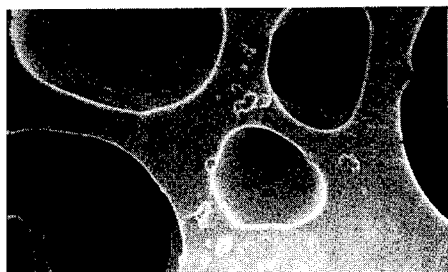
Allitus consists of three layers. The surface layer consists of hundreds of microscopic holes which enable the production

of Allitus, a fully customised leather. Not only can any color and pattern be created, but ventilation, permeation and water resistance levels can be tailor-made. The revolutionary core (sponge) layer does not require any toxic substances in its formation. A water-based medium incorporates minute pouches which are interlinked to form a truly breathable, lightweight leather. The unique threads which made up the fiber layer are first spun, then split further into superfine interwoven fibers, so that an elastic yet strong material is obtained.

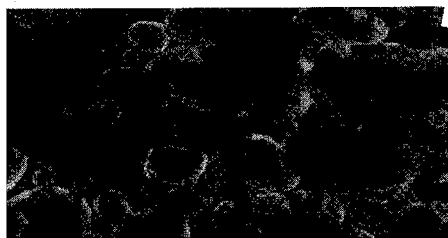
With this new manufacturing technique, the energy consumption rate is also decreased, so the scales of the necessary production facilities such as the boiler as well as the power consumption rate are halved, and the carbon dioxide volume discharged by the enterprise is decreased considerably. Allitus manufactured in this manner has a permeability that is nearly ten times that of genuine leather, weighs only one-half, and the water absorbency is increased by about 20% (tests conducted by the company). Due to these excellent features, it is ideal for use as a material for producing sports shoes which are light and do not become hot and stuffy.

\* **Koatsu Cloth Co., Ltd.**

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Surface layer



Revolutionary core (sponge) layer



Fiber layer

## Construction & Transportation

98-03-006-01

### High-Elevation Work Lorry with Rear Slewing System

S-mac Co., Ltd. has started marketing a newly developed high-elevation work lorry ST100 for installing and repairing electric and telecommunications equipment. The lorry has a slewing mechanism positioned at its rear. According to the company, this is the first high-elevation (working at heights of 10 meters) work lorry equipped with a rear type slewing system. The lorry is marketed at a domestic price of ¥750,000.

Due to this novel design, the scope of work that can be performed has been expanded substantially compared with its counterparts with the slewing mechanism positioned at the central part. Bucket positioning is also accomplished with ease, and since the buckets are placed on the ground, getting on and alighting from the lorry are achieved with much greater ease than before. In addition, to protect workers from electric shock accidents, the buckets and third boom are coated with fiber reinforced plastic (FRP).

A tool box is mounted on the slewing mechanism to accommodate parts, materials and tools, and the tool box is slewed together with the slewing axis. The work lorry has an overall length of 4.7 m, width of 1.8 m, and can carry a load of 500 kg.

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98-03-006-02

## Durable Type Oil Seal With Two-Stage Rib Structure

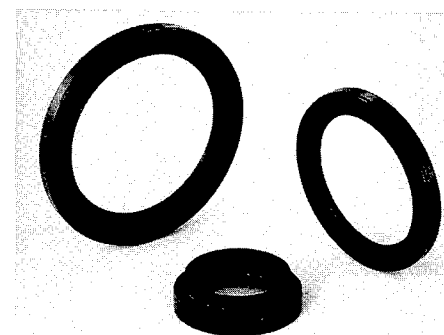
Koyo Chicago Rawhide Co., Ltd. and Koyo Seiko Co., Ltd. have started the mass production of a newly developed oil seal Super Helix Seal featuring a two-stage helix lib structure which permits pumps to retain their functions even if the first lib is worn out. The new oil seal has a service life that is doubly long. It also features excellent lubrication that decreases its lip wear by about 30%, by which both the sealing ability and lubrication are improved substantially.

The research team analyzed the mechanism of pumping (effect of returning leaked fluids) that occurs in the micro

voids at the shaft of revolution and the edge of helix libs, and devised an oil seal with ribs formed in spiral form of optimum two-stage spiral lib height of 0.05 mm and 0.2 mm. Due to this two-stage helix rib design, the first-stage rib of lower height comes into contact with the shaft in the initial term of oil seal usage. When the lip wears out, the second-stage rib of greater height comes into contact with the shaft. An wide lip contact is maintained even when a rib wears out, so the pumping force is retained. Other performances are comparable to those of existing oil seals, and the specific type of rubber can be selected in conformance with the oil seal application.

Previously, the oil seal was of single-stage construction with a lib height of 0.05 mm, so that the pumping force was decreased in conformance with the oil seal wear to cause fluid leakages.

Koyo Chicago Rawhide has installed special-purpose production equipment in its head office factory and commenced mass production of the new seal for use in the crankshafts of automobile engines. The company plans to venture into the mass production of oil seals for transmission systems within the year.



Super Helix Seal

**\* Koyo Chicago Rawhide Co., Ltd.**

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98-03-006-03

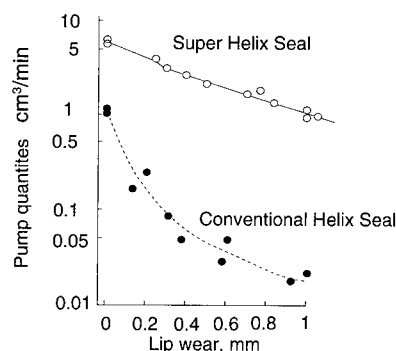
## Portable Type Instantaneous Refrigerating-Equipment Applied for Special Boxes/ Containers Developed for Fresh Food Deliveries

Cool Pack System K.K. has developed portable type instantaneous refrigerating-equipment which is applied for specially designed boxes/ containers used in transportations of fresh foods, both chilled and frozen.

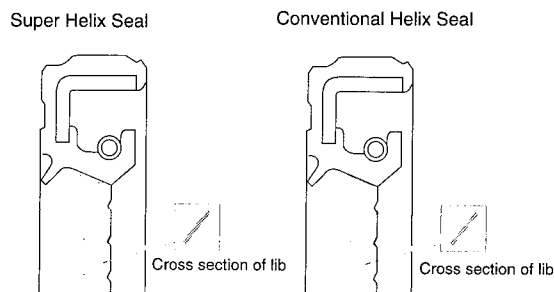
This portable type instantaneous refrigerating-equipment is called as Master Cool Portable. Master Cool Portable is designed to be located on the deck of trucks. Therefore, chilled and frozen foods can be transported even for long-distances with ordinary trucks having no cooling devices.

Master Cool Portable is used in conjunction with a 49 liter-cylinder containing liquefied carbon dioxide, and is easily movable. During actual use of Master Cool Portable, put the nozzle of the equipment, from which liquefied carbon dioxide is ejected, is put into the mouth of a special box or a special container. The volume of liquefied carbon dioxide to be injected into the box or the container is easily adjusted manually at the control box. Therefore, drivers of trucks can operate Master Cool Portable quite easily.

Master Cool Portable-I is used with special boxes. After determining the temperature level, at which fresh foods are kept, a special box is placed on the load deck of



Lip wear-pump quantities relationship



Structure

the suitcase shaped Master Cool Portable-I. The nozzle is put into the mouth of the box and liquefied carbon dioxide injected for 5-30 seconds. The ambient temperature inside the box is cooled down instantaneously.

Master Cool Portable-II is used with special containers. After determining the temperature level at which fresh foods are kept, the nozzle is put into the mouth at the back of a container. Liquefied carbon dioxide is injected for 10-60 seconds for cooling down the ambient temperature inside the container instantaneously. If a Master Cool Portable-II connected to a cylinder containing liquefied carbon dioxide is loaded on the deck of a truck and injections of liquefied carbon dioxide are repeatedly conducted, long-distance transportations of fresh foods, which require many hours, become possible.

Master Cool Portable system enables transportation of fresh foods contained in special boxes or containers with the insides cooled down by injections of low temperature liquefied carbon dioxide. When liquefied carbon dioxide is injected into special boxes or containers at normal temperature, its volume expands to about 280 times instantaneously. Theoretically, about 47% becomes snow-like dry ice, while about 53% becomes cold gas. The temperature of snow dry ice is as low as  $-79.8^{\circ}\text{C}$  and its rapid cooling effect lowers the inside temperature of a box or a container down to  $-30^{\circ}\text{C}$  or  $-40^{\circ}\text{C}$  level. Then, it rises to a temperature level which is equivalent to the surface temperature of fresh foods contained in the box or the container. This temperature is called the saturating temperature. The time required to reach the saturating temperature depends on the conditions given but is about 20 minutes to two hours under normal conditions. This the temperature of fresh foods inside the box or the container to be maintained at the required temperature level for 12 hours.

Meanwhile, carbon dioxide gas pushes out the air contained in the box or the container so that the component of gas inside the box or the container is changed. This is so-called the gas pack effect. This suppresses the proliferation of aerobic bacteria so that decay and/ or decomposition of

meats and fishes are prevented. It also suppresses the over-ripening of vegetable and fruits.

Master Cool Portable provides users with more precise temperature controls when compared with a system using frozen heat-absorbing materials. The advantages of Master Cool Portable are transportation for long distances during which injections of liquefied carbon dioxide are repeated so that the adequate temperature is controlled for long hours, and at supermarkets/ storehouse where fresh foods are temporarily left outside refrigerators for few hours.

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98-03-006-04

## Liquefied Hydrocarbon Leakage Detection System

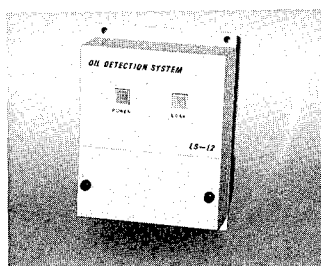
Toyo Automation Co., Ltd. has started marketing a liquefied hydrocarbon leakage detection system LS-12 Oil Leak Detection System to monitor oil leakages for 24 hrs, and is sold at a domestic price of ¥180,000.

The system consists of a leakage sensor based on polymer technology and a special-purpose detector. The sensor consists of a electrically conductive polymer complex consisting primarily of silicone rubber that expands and its electrical resistance value increases when it comes into contact with liquefied hydrocarbon. The change is measured with an arithmetic circuit, and an alarm is generated.

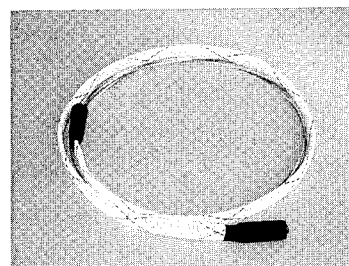
Therefore, even slight leakages are detected very accurately to transmit the situation to the sensor instantaneously and to generate an alarm. The sensor unit consists of fine tubing and can be installed with ease. Also, the system is maintenance-free and displays its performance fully in cold regions as well as under frozen conditions.

The company anticipates that the system has a wide range of applications, such as building facilities, piping, around pits and tanks, industrial plant facilities and gasoline stands.

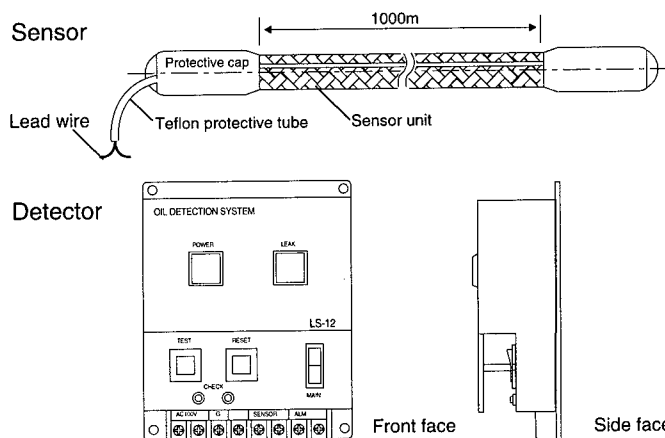
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Detector



Sensor



Construction drawing



## Energy & Resources

98-03-007-01

### Acoustic Detection of Deterioration of Electrical Facility Insulation

Kawasaki Steel Corp. and Kawatetsu Advantech Co., Ltd. have jointly commercialized a Discharge Detection System MK-710 that applies the acoustic technique to detect the insulation deterioration of all types of electric facilities such as transformers, distributing panels and capacitors.

To diagnose the deterioration of insulation which causes current leakages and various electrical facility problems, the generally accepted method is to cut off the power of the electric facility prior to measuring the insulation resistance. The new discharge detection system enables insulation diagnosis with the line in the active state, which permits early discovery of insulation deterioration by the substations of electric power companies as well as the substations of instrumentation-oriented industries such as the iron & steel and petrochemical industries.

The company perceived that the discharge sound accompanying insulation

deterioration has a fixed cyclic behavior, and that when a partial discharge occurs, an ultrasonic wave is generated over a broad bandwidth. This ultrasonic wave is synchronized with the power source phase and intensifies or deteriorates the phase, so modulating the detected noise and analyzing the frequency spectrum generates numerous frequency components having double the frequency of the power frequency. MK-710 can achieve rapid FFT analysis by DSP, so partial discharge can be detected continuously. The system is designed to detect the allowable discharge of a molded insulator made of epoxy resin prescribed by the Japanese Industrial Standards. The corona discharge is measured continuously, the envelopes detected, then the 100 Hz (or 120 Hz) spectrum components analyzed. An alarm sounds in conformance with the ratio of the spectrum components with respect to the total measurement bandwidth. The alarm levels are fixed and sounded in three stages depending on the degree of excess spectrum components.

The detector is compact ( $19 \times 9 \times 11$  cm), weighs only 1.6 kg, and can be oper-

ated with ease. In daily electrical facility inspections, the inspection time can be shortened by about 50%. The detector is marketed at a domestic price of ¥800,000, and Kawatetsu Advantest will be in charge of the detector manufacture and sales.

\* **Kawatetsu Advantech Co., Ltd.**

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98-03-007-02

### Emulsified Fuel Using 2:1 Petroleum/Water Mixture Ratio and Combustion System

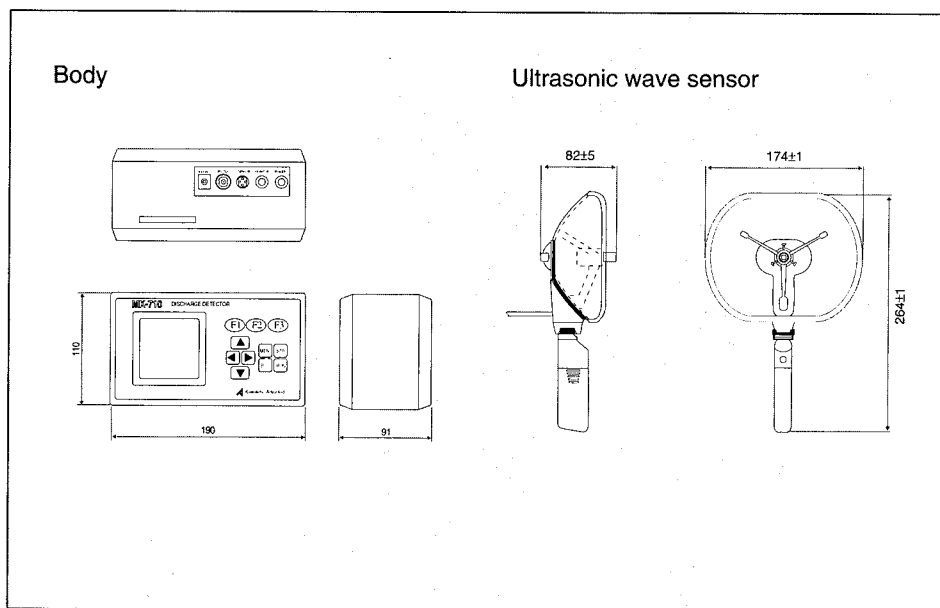
I.C.T. Co., Ltd. has developed a new type of fuel BENERGY that reduces the emissions of CO<sub>2</sub> by 38.8% and NO<sub>x</sub> by 66.6% compared with kerosene, as well as an ancillary combustion system Intermix Burner System for combustion of the new fuel. The fuel is marketed at a domestic price of ¥1,300/kg and the combustion system at a price of ¥5.2 million.

With this new fuel, kerosene is added to water at a ratio of 2:1 or 6:4, with 0.6% surface boundary active agent, then stirred to form an emulsified fuel. The addition of water decreases the emission of NO<sub>x</sub>, CO<sub>x</sub> and SO<sub>x</sub>, and the fuel can be combusted completely even in lack of excess air, so compared with the combustion of kerosene, the combustion of oxygen in the atmosphere is decreased considerably. In addition, the fuel features an excellent heat transfer coefficient comparable to that of kerosene.

The surface boundary active agent is decomposed completely during combustion, and the combustion temperature is over 1,300 °C, at ratio of 2: 1 which reduces the use of kerosene to two-thirds. The combustion system is sold for use as an incineration furnace or in air conditioning. It consists of a mixer-feeder for stirring the fuel mixture and a water tank. Existing boilers can be used intact to permit complete combustion in a state of reduced air feeding.

\* **I.C.T. Co., Ltd.**

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166-0001  
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Discharge detection system

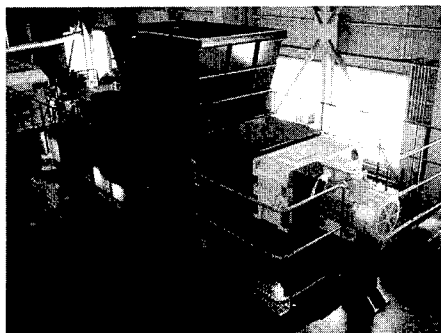
## Environment

98-03-008-01

### Biaxial Shearing Crusher of Excellent Capacity

Retro Niigata Co., Ltd. has started accepting orders for a newly developed biaxial shearing crusher featuring a treatment capacity that is 1.5 times that of conventional counterparts. It serves to improve the combustion efficiency of industrial wastes by crushing the wastes prior to incineration, thus suppressing the generation of dioxin.

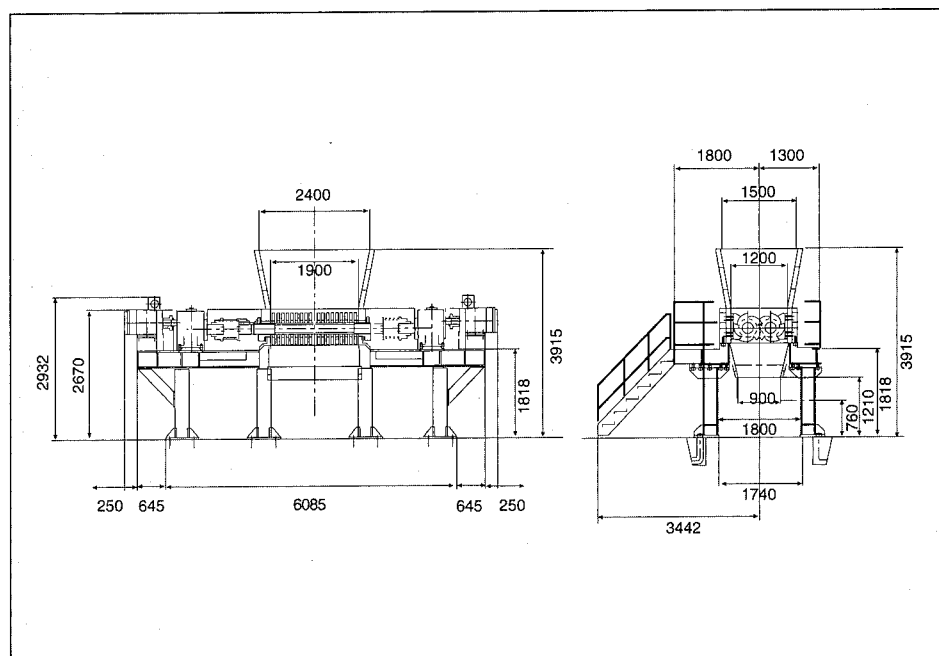
The new shearing crusher RD-800 is a biaxial type in which the waste is caught and crushed with a pair of revolving blades. It is not a swing boom type like the single-axis shredder, so vibration is minimal and there is no need for any special type of foundation. The drive force has been increased by changing the motor mounting position, by which the treatment capacity has been increased by 50% to 24 t (in 8-hr operation) compared with existing shearing crushers. The diameter of the rotary blades is larger by 20%, so the crusher is usable for working with large refrigerators which had been impossible previously.



Biaxial shearing crusher

RD-800 features a simple construction that is highly resistant to problems and maintenance is performed with ease. The crushing targets are home electrical appliances such as washing machines, refrigerators and TV units, data processing equipment such as personal computers, word processors and copiers, and construction wastes.

This shearing crusher is used in the crushing process prior to combusting industrial waste with an incinerator, and may also be used for sorting wastes for recycling without burning these wastes. The standard model of RD-800 is marketed at a domestic price of ¥50 million.



Dimensional drawing

\* Retro Niigata Co., Ltd.

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Tel: +81-258-22-3291

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98-03-008-02

### Simultaneous Treatment Agent for Black Smoke, Odors, Dioxin and Fly Ash Containing Heavy Metals

Kohmix Co., Ltd. has developed Liquid Ceramics, an effective absorbent for black smoke, odors, dioxin precursors, and fly ash containing heavy metals.

Liquid Ceramics is an alkaline mixture of special silanol and siloxane, with film-forming character at low temperature, showing the intumescence phenomenon formed by incineration emission, then hot gas filtration.

Liquid Ceramics is injected into the emitted gas, when 99% of substances forming volatile HCl and dioxin precursors are absorbed simultaneously, making odors and fly ash harmless. Liquid Ceramics acts as a hot gas bubbling filter due to the intumescence phenomenon, enclosing black smoke and odors, as well as fly ash with heavy metals. Liquid Ceramics becomes a stable quartz substance containing ionically bonded heavy metals with a melting point of over 800°C.

Liquid Ceramics is added to water for spraying at only 200 - 400 g/ton. The company has requested a furnace manufacturer to make a compact furnace that incorporates a spraying system to inject Liquid Ceramics into incineration emissions.

\* Kohmix Co., Ltd.

Public Relations Dept.

5-20-6, Honson, Chigasaki City, Kanagawa

Pref. 253-0042

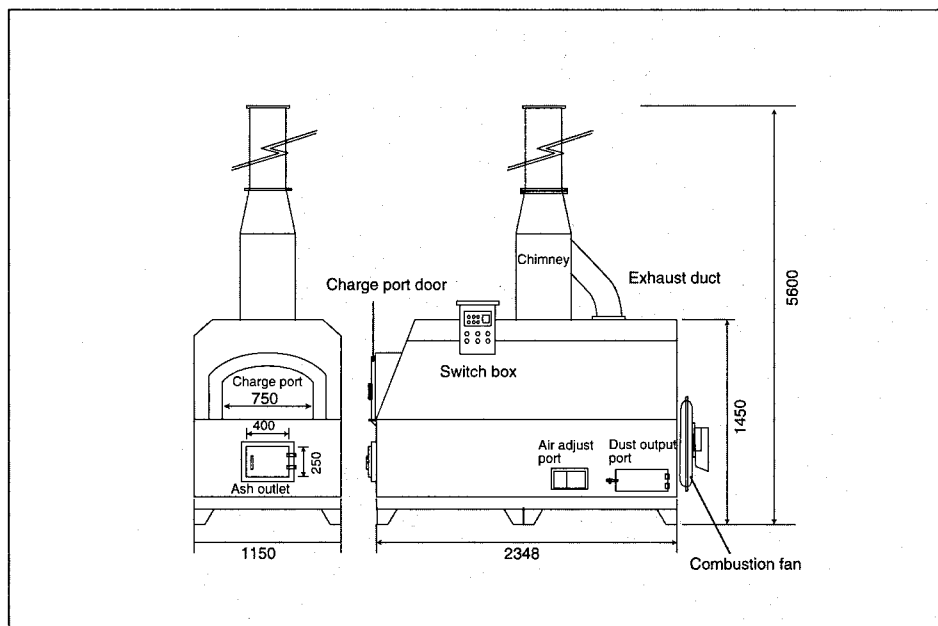
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Fax: +81-467-53-2800

98-03-008-03

### Compact Incinerator Improves Environment by Suppressing Dioxin

Asada Corp. has already developed the compact incinerator "ACE" that combusts wastes at a high temperatures of over 1,000 °C and accordingly can suppress dioxin to below the standards set by the Japanese government. It has started marketing the Incinerator through Sanko Sakai Trading Co., Ltd..



Dimensional chart



ACE

Inside the Incinerator, a special type blower (Patents applied for) is installed for blowing off 500 °C hot air into the furnace and keeping the inside at 1,000 to 1,300 °C, so ACE can completely combust wastes, although existing incinerators could not.

Generally, by combustion at an extremely high temperature, the incinerator is smoke-less, ash-free and does not emit bad smells. ACE can reduce the residual ash to less than 1/3-1/10 compared with existing incinerators on the market.

The dioxin emission control regulation came into effect on December 1, 1997, and new incinerators such as ACE are expected to replace existing incinerators which do not match the dioxin emission regulation in hospitals, schools, hotels, supermarkets and agricultural cooperatives.

For ACE, it is unnecessary to sort out waste by kinds of garbage before combusting, and the completed combustion is smokeless and odorless for combustion of raw garbage, construction wastes, medical refuse, paper diapers, lawn grass and other wastes of water content up to 90%.

According to the analysis of dioxin, in the case that waste produce of 1.4 ton per day is combusted, ACE Incinerator only 1.7 ng/m<sup>3</sup> of dioxin, far below the standard regulated by the Ministry of Health and Welfare.

The monthly running cost has been established to be less than ¥100,000 using waste oil and waste solvents as auxiliary fuels.

The combustion capacity of ACE was also recognized to be 490 kg of medical refuse, 210 kg of waste plastics, 42 waste tires and 560 kg of garbage, respectively, per day.

Between three to four units of ACE Incinerator are operable by one-man (operator) since ACE's combustion technology is simpler.

The price of a standard type of ACE in Japan is ¥10,175,000/unit.

**\* Asada Corporation (Manufacturer)**

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**\* Sanko Sakai Trading Co.Ltd. (Dealer)**

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## Biotechnology & Medical Science

98-03-009-01

### Mitochondrial Genotype Associated with Longevity

A research group at Gifu International Institute of Biotechnology has identified a mitochondrial genotype Mt5178A that suppresses the occurrence of adult-onset diseases. This finding confirms that longevity is dependent on genetic factors. This genotype was identified by statistical comparison of the frequencies of genotypes

among centenarians, normal blood donors, and patients.

To evaluate the effect of mtDNA variations on the occurrence of diseases, they analysed the frequencies of Mt 5178A and Mt5178C in 338 randomly selected patients. The age distribution of the patients indicated that the frequency of Mt5178C was almost the same as that of Mt5178A among the young patients, whereas the frequency of Mt5178C increased more markedly than that of Mt5178A among old pa-

tients. The difference in the frequencies between Mt5178A and Mt5178C was less marked in old male patients than in old female ones; the protective effect of Mt5178A against occurrence of adult-onset disease may be weaker in males than in females. The ratio of Mt5178 A/C was significantly lower in the old patients than in both the centenarians and the healthy controls.

The statistical analysis revealed that occurrence of adult-onset diseases was influenced by the difference in the nucleotide at position 5178, either adenine (A) or cytosine (C), of mitochondrial genome (mtDNA), which consists of 16569 nucleotide pairs. Individuals with Mt5178C (cytosine at nucleotide position 5178) are more susceptible to adult-onset diseases than those with Mt5178A (adenine at nucleotide position 5178); the difference is statistically significant at age>45.

Although individuals with Mt5178A are relatively rare among the global population (6 among 147 samples from various races obtained in California), the frequency of Mt5178A is 45% in Japan.

Each cell has hundreds of mitochondria, which serve as energy sources. Mitochondria produce the energy (ATP) necessary for various cellular activities (muscle contraction, activity of neurons in the brain etc.).

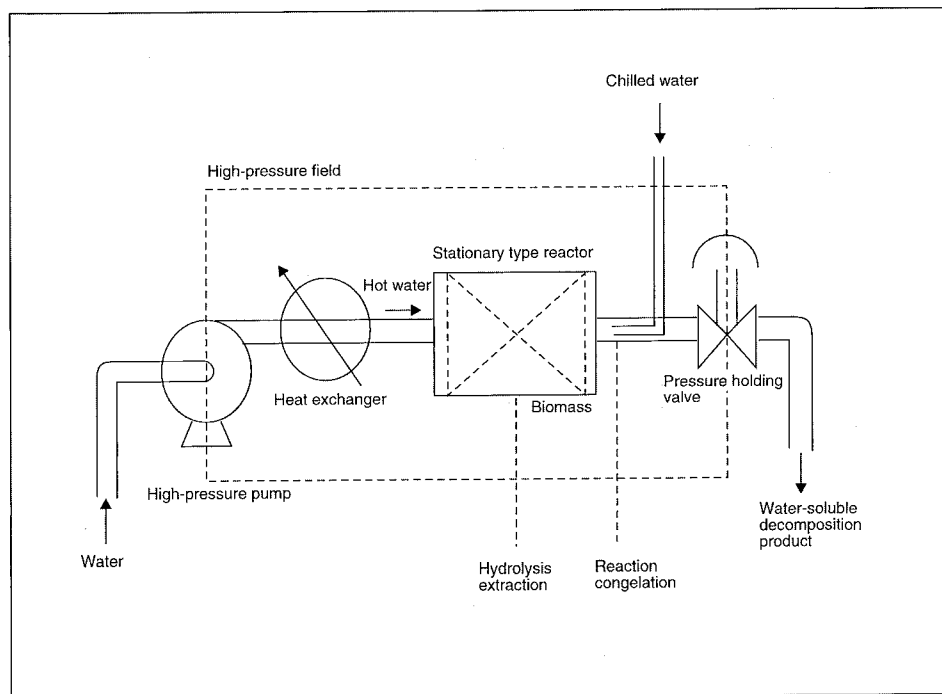
Mitochondria originate from a bacteria that started symbiosis with ancestral cells. mtDNA encodes core parts of the mitochondrial respiratory chain. Sequence diversity of mtDNA is marked between individuals, because the evolutionary rate of mtDNA is 5-10 times higher than that of nuclear DNA. [Reference: Lancet 351: 185-186, 1998 (January 17 issue)]

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98-03-009-02

## Rapid and Efficient Manufacture of Water-soluble Oligosaccharide

The Materials Chemistry Department of the Kyushu National Industrial Research Institute, Agency of Industrial Science and Technology, has established a process us-



*Decomposition of biomass by hot water flow type reaction process*

ing cellulose to manufacture water-soluble oligosaccharide as a functional food ingredient. Oligosaccharide has been manufactured successfully for the first time by hydrolysis using pressurized hot water. Glucose, a substance for alcohol fermentation, is also produced at the same time, so the new process is linked to effective utilization of vegetable biomass.

Oligosaccharide was manufactured by switching the cellulose decomposition process from the batch process to the continuous process. The Hot Water Flow Type Reaction Process greatly simplifies the control of the processing temperature, pressure and necessary conditioning time, which are quite difficult to control by the batch process.

Cellulose powder is filled in the new system stationary type reactor, and pressurized hot water heated to 200-300 °C under 5-10 MPa is passed through the system, by which 50% of oligosaccharide and 30% of glucose are produced from 100% of raw material cellulose. The formed water-soluble oligosaccharide is separated (independently) from the aqueous solution by an ordinary process, then purified for utilization as a functional food additive.

An enzyme is added to a hydrolyzate consisting primarily of water-soluble oli-

gosaccharide obtained through cellulose hydrolysis treatment, followed by further hydrolysis, by which glucose is produced. The enzymatic decomposition method can be the normal enzymatic decomposition method using the conventional type of cellulose, the batch process may be adopted, or the continuous bioreactor process using immobilized enzyme may also be used. Enzymatic decomposition is accomplished most efficiently by using the enzyme at its optimum temperature and as close as possible to its optimum pH value.

By performing pressurized hot water treatment, the oligosaccharide dissolved in water can be contacted with the enzyme effectively, in contrast to solid-state cellulose, so glucose formation can be accomplished quickly for efficient production. The research team plans to further optimize the temperature, pressure and other processing conditions and to establish a sound technique to control the ratios of manufacture of oligosaccharide and glucose.

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**Japan External Trade Organization**  
**Machinery and Technology Department**